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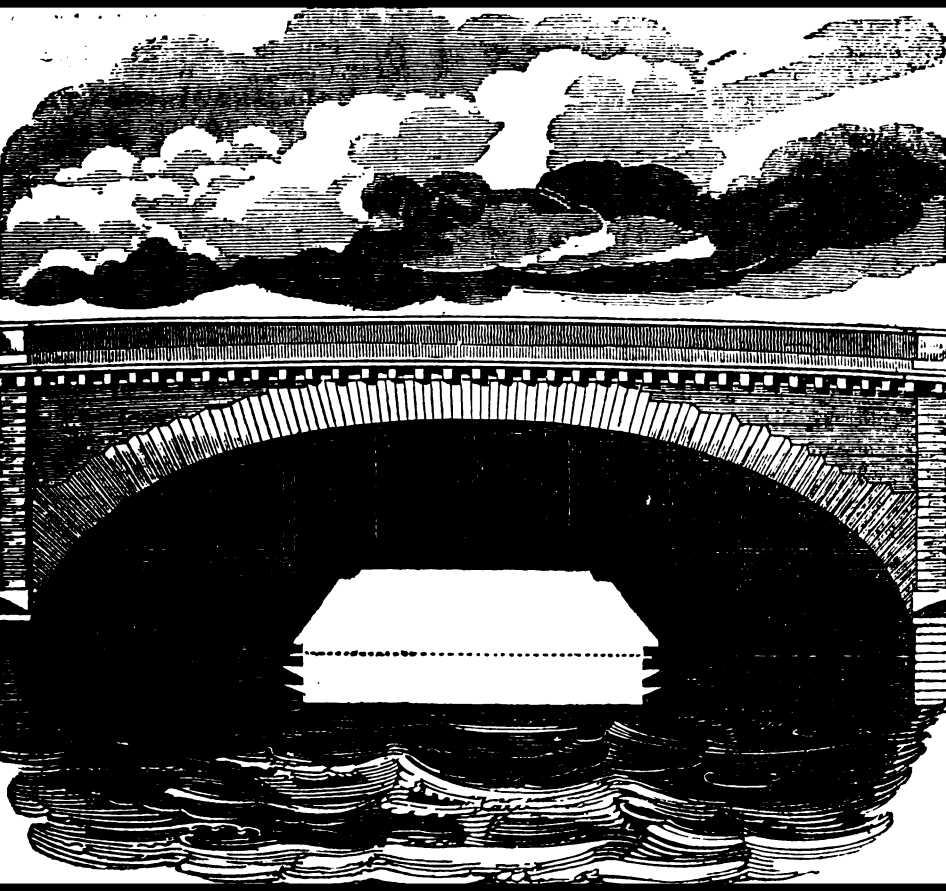

The Mechanics' Magazine, Museum, Register, Journal, ...

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THE

MECHANICS' MAGAZINE,

MUSEUM,

Register, Journal,

AND

GAZETTE.

VOLUME THIRTEENTH.

" If those who are occupied in the proper business concerns of life, and its severest toils, had really no time for study, then would the great mass of society be doomed to perpetual mental degradation; but every man can spare at least one hour in the twenty-four to the improvement of his mind; and one hour a day is about equal to four entire years in every twenty; which, so far as time is concerned, is sufficient to complete as extensive and varied a course of study as can be pursued from entering to leaving college. With this one hour at his command, each man has the principle of freedom in his own bosom; and will be a nobleman and gentleman—a scholar and a philosopher, though he toil at the desk or in the shop, or in the field, for his daily livelihood."—*The Freedom of the Mind.*

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PREFACE

TO

THE THIRTEENTH VOLUME.

A JOURNAL which, like the "MECHANICS' MAGAZINE," consists principally of the spontaneous contributions of a particular class of readers, will always possess the peculiar merit of reflecting with great vividness the impressions which are uppermost in the minds of that class. Whatever concerns or interests them most, for the time, is sure to be more fully treated of there, than any where else. Were any one asked, 'What are the subjects which, during the past year, have most occupied the attention of scientific men?' he would doubtless answer—'Railways and Steam-carriages.' And, on referring to this new Volume of our Work, it will be seen that Railways and Steam-carriages form, accordingly, its leading themes. It may, with great safety, be asserted, that in no other Journal of the day, is there to be found so much valuable information on these all-engrossing topics, or so many helps to the progress of improvement in the application of steam power to locomotive purposes.

The other matters, of which the present Volume is made up, will be found distinguished by the same features of variety and usefulness which have characterised the "MECHANICS' MAGAZINE" from its commencement. Almost every branch of knowledge, and every walk of life,

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has contributed something original to the fund of information and amusement here collected.

On the General Principles of Physics, there are some Essays by Mr. Hopwood, not more remarkable for the great clearness of their style, than for the new and (we apprehend) sound views they contain.

To the elucidation of Practical Mechanics, Mr. Davy and Mr. Baddeley have, as usual, contributed largely; so also have Mr. Harrison and S. Y., even in the midst of a fierceness of controversy, not very favourable to the interests of truth. For many valuable communications to the same department, we are indebted to Mr. Cheverton, Mr. Saul, Henry D., Miliwal Thingk, a Country Curate, S. P. B., B. S., and other occasional Correspondents.

The New Inventions brought into notice are numerous, and some of them of great promise; we may mention, in particular, the Perpetual Lever of Mr. Franks (p. 366); the Buhlcutting Machinery of Mr. M'Duff (pp. 129, 287); Mr. Lacey's Apparatus for Suspending Carriage-bodies (p. 274); Messrs. Braithwaite and Ericsson's Method of Manufacturing Salt (p. 418); Jenour's Brittle Charges, p. 419; and Long's Wooden Frame Bridges (p. 434).

The department of Mathematical Inquiry continues, with the aid of O. C. F., Mr. Woollgar, G. S., Mr. Utting, Mr. Jopling, R. C. jun., Mr. Hubert, Mr. Hughes, Amicus, and other learned contributors, to be sustained with a degree of ability which has given the "MECHANICS' MAGAZINE" a place, second to none, among the publications devoted to this branch of knowledge. The present Volume contains the new set of Logarithmic Tables, by Mr. Woollgar, which we announced in the Preface to our last Volume. They are the most concise, we believe, ever published, yet com-

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prehensive enough to serve all ordinary purposes. With the aid of these Tables, and of the excellent Portable Trigonometry of P. M. W., given in our last Volume, there is little in the way of practical calculation, whether in the closet or in the field, which a person may not be readily able to perform.

The Public Improvements going on, or in contemplation, have also come in for a due share of attention. The New London Bridge and its approaches, the Stone Tramway, Commercial Road, the Portland Breakwater, and the improvement of the Lune, form each the subject of interesting and instructive papers.

Nothing can be conceived farther from probability, than that a work, which is thus in every page characterised by so exclusive a devotion to the diffusion of information on Mechanical and Scientific subjects, should ever have had to vindicate itself from an imputation of disseminating pernicious principles in religion and politics! Yet so it has happened. A report was some time since generally current, that an eminent Divine had, on a particular occasion, denounced the "MECHANICS' MAGAZINE," by name, from the Pulpit, as a vehicle of irreligion and sedition! The Editor felt it due to himself, and to his numerous respectable Readers and Correspondents, to trace this report to its source, and to require that the charge, if it had really been made, should be retracted. The result will be found explained, in a very candid and satisfactory letter from Dr. Chalmers, published in the present Volume, (P. 256.) The Reverend Gentleman *had* incautiously used a form of words that admitted of the meaning generally affixed to them, but was so far from really intending to pass any censure on the "MECHANICS' MAGAZINE," that he freely expresses his conviction, that, "next to direct Christian Instruction, such a Journal, conducted on

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the principles which it avows, and adequately supported by the public demand, is entitled to rank among the most efficient of those auxiliary means which are now in operation, for raising the character, and eventually the condition, of the people at large." The "MECHANICS' MAGAZINE" has been honoured by many strong testimonies of approbation; but by none which the Editor is disposed to hold in higher regard, or which is likely to be more regarded by others, than this of Dr. Chalmers; at once the first of Preachers, and the first of Religious Writers,—an ornament alike to the Piety and the Literature of the age.

J. C. R.

115, *Fleet Street*,
September 1*st*, 1830.

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Mechanics' Magazine,
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 343.] SATURDAY, MARCH 6, 1830. [Price 3d.

CENTERING OF THE NEW LONDON BRIDGE.

DESCRIPTIVE ACCOUNT OF THE PRINCIPAL BRIDGES ERECTED OVER THE RIVER THAMES. BY MR. C. DAVY, ARCHITECT.

No. IX.

New London Bridge—Rennie, Architect—1824-1830—*Progress of the Works—Alteration in the Design—Construction of the Centering.*

(Continued from p. 458. vol. xii.)

All preliminary matters being settled, the works proceeded, with few exceptions, in the following order:—

1824.—In this year great progress was made in the erection of the coffer-dams for the south piers of the centre arch, and the adjoining arch southward, and also for the Surrey abutment. The works were somewhat retarded, however, by the removal of immense quantities of stone and rubble from the bed of the river, which had from time to time been thrown in around the piles of the starlings for their preservation. Several purchases were also made this year of property on the Surrey side for the formation of that abutment.

1825.—On the 27th of April was

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completed the first coffer-dam and the first stone laid, as is described in a former paper, (No. IV.) The Surrey abutment was also completed. The centres for the first and second arches (Surrey side) were set, and the arches proceeded with to a considerable extent. The coffer-dam for the third pier was completed, as was the foundation of that pier. Purchases of property in Southwark were made, and other purchases on the City side for the City abutment.

1826.—The difficult operation of throwing two arches into one, (Surrey side) described in paper, No. IV., was carried into effect. "This important work was commenced on the 30th of March, and completed in the short space of five weeks, without stopping either the foot or carriage-way over the bridge during that period."*

1827.—The first and second arches on the Surrey side, the masonry of the third pier, the coffer-dam, the foundation, and the masonry of the fourth pier, were all completed. The third and fourth sets of centres were fixed, sundry buildings taken down on the north shore, and the City abutment coffer-dam commenced. Two other arches of the old bridge were converted into one by a timber-framing similar to that before described. Farther purchases on the City side were made this year, and a part of the ground on the south front of Fishmongers' Hall was taken in for the convenience of carrying into execution the City abutment.

1828-29.—The third and fourth arches, the City abutment, and the fifth and last arch completed; the centres of the first and second arches removed.

23rd of July, 1828.—The key-stone of the land-arch (Southwark side) was set in the presence of the Committee of Works; it consisted of a block of red Peterhead granite, measuring 4 feet 6 inches deep, 2 feet 3 inches wide, and 18 inches thick, and weighed about 2 tons. This was the first arch that was completed.

The greater part of the materials employed in the erection of the bridge were provided during the year 1825, and deposited at the Isle of Dogs, where they were also prepared previous to being used.

Of the Centering of the New London Bridge, and Centering in general.

The account of the progress of the works has necessarily been the means of my now directing the attention of the readers of the "Mechanics' Magazine" to the construction and use of those immense timber-scaffoldings called "Centres." Where a compact body of materials is used for the purpose of forming a concavity, such as groins for vaults, domes,* archways, and occasionally openings nearly square, the framings called centres are fixed, for the farther purpose of upholding those materials which by their density and inclined position could not be supported otherwise, until the cement which connects them is properly hardened by time. To treat upon this subject by itself to its full extent would involve the contents of several papers; the different varieties of centres, therefore, will be described under the heads of the respective bridges they were severally employed in.

The conditions for a centre are very similar to that of roofing, provided a horizontal tie-beam can be introduced, but in navigable rivers this must at times be dispensed with, and then the matter requires greater consideration. We must see in what manner opposing forces are exerted, and act accordingly. 1st. In centre-framing its strength must exceed the weight placed upon its convexity, in the form of the voussoirs, or arch-stones. 2nd. All openings or spaces between the timbers should be triangles. 3rd. All quadrilaterals should be avoided if possible. 4th. Equilibrium should be as much studied in the centre as in the stone arch; for should a weakness discover itself on one side, and stability on the other, by the framing being unequally divided, a cripple in the arch itself will be the result.

In all these particulars the present centre of New London Bridge displays

* Report of Bridge Committee, (Oct. 1828.)

* It is possible to construct domes without any centre.

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a knowledge of the right principles of construction worthy our notice; and a full exposition of this practical application of them, will form part of the next paper. For the present, the prefixed engraving will give an exact idea of its construction, and the contour of the centre arch with its voussoirs. There are about nine of these framings to each arch, boarded over with very stout planking, placed within two or three inches of each other. The centre consists of two parts. The first division embraces the greater portion of the curve at the place where the tie-beam passes through. The second is the part supported on piles driven into the bed of the river; this is fixed. The upper part may accordingly be gradually lowered by removing the wedges, thus preventing any sudden settlement.

(To be continued.)

MOMENTUM OF FALLING BODIES.

Sir,—Your anonymous correspondent (No. 314, p. 424) is undoubtedly entitled to my acknowledgments for advising me to write with care. It seems his attention was so completely engrossed respecting the propriety of what I had advanced, as to cause him to neglect that advice himself which he was so freely bestowing upon me; for his whole paper bears such evident marks of carelessness, that any one would conclude it had never occurred to him to read it over after having thrown the particulars together. He quotes my words (No. 308) respecting the velocities of falling bodies being in half the ratio, (p. 324) and in subduplicate ratio, (p. 325) of the heights from whence they fall; and, after begging me for my own credit's sake not to publish such matters, simply asks, "Is the velocity in half the ratio, and also in the subduplicate ratio?" And though this must be answered in the affirmative, (subduplicate ratio and half the ratio being the same thing) yet it is to be observed that any person taking exceptions at another's expressions before he has considered the subject to which they relate, so far as to inform himself of their meaning, cannot but imply thoughtlessness in the extreme. As to perspicuity, it is certain that nothing can be perspicuous to a person who will not take the trouble to see. He tells us that Sir Isaac Newton declares that "the quantity of motion is the measure of the same, arising from the velocity and quantity of matter conjointly;" but he has not told us *the measure of force* Sir Isaac shows to be necessary to stop such motion, although this is the only point at issue. With respect to my supposing a case that cannot occur, as it served the intended purpose completely, there could be no impropriety. It showed that the force required to resist a falling body is equal to both its ascent and descent, and that the force of the latter is sufficient to effect the former, and must therefore of necessity be equal to it; and it is known that the velocity is only as the square roots of the heights of the fall.

It seems rather odd that this gentleman cannot understand that *two forces* are necessary to keep two bodies asunder that are drawn towards each other by attraction; and also that he cannot perceive that it is himself and not me that "talks about forces being equal to velocities," although he need only read his own paper to be convinced of this; he will there see that it is *the forces not being equal to the velocities*, but equal to the squares thereof, that I talk about.

In return for his advice, however, I must recommend him to endeavour to be consistent the next time he writes. A writer should always be able to perceive when he contradicts himself; and he ought to take especial care not to falsify in the next line what he has said in the preceding one. He quotes the words, "the recoil of the mortar gives a pressure over and above its weight, equal to the *square of the time* or velocity of the ascent"—and then says, "here we have *pressure*, *time*, and *velocity*, all to be made equal to each other;" as though *simple velocity* and *the square thereof* was one and the same thing! He doubtless would stare were he to be told that the velocity in feet which a falling body acquires in one second of time, differs from the square thereof by upwards of a thousand, and

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that in inches the difference is 148610.*

It is a false assertion that "the *square* of a *velocity* is said to be *equal* to a *double pressure*," because no such thing is said, neither is it the case. But as veracity is one of the most essential qualifications of a critic, it certainly ought not thus lightly to have been disregarded. It should have been shown wherein my expressions implied that a faggot of wood is equal to a flaming furnace, and in what way it makes the truth of my assertions "conspicuous to all," and establishes the position, that the momentum of bodies is proportional to the squares of their velocities.

As Sir Isaac Newton never gave an opinion respecting the force or momentum of falling bodies—not even when that matter was discussed by the philosophers of his time—it follows that there is no ground for alleging that I have said any thing in defiance of him. But the axiom, that the resistance required to destroy motion is equal to the force by which it is produced, is universally admitted; and that such force is as the square of the velocity, I conceive to be neither difficult to demonstrate on philosophical principles, nor to determine experimentally. Of course, I do not entertain this idea because it was "the opinion of Leibnitz," or of any other person, but for the simple reason, that it plainly appears to be fact. I must, however, defer the demonstration to a future Number, when I intend also to describe a very simple apparatus on a principle which will render the experiment both effectual and evident.

The encomium of this correspondent on the observations contained in the second paragraph of my rejoinder (No. 308) is quite in character with the rest of his paper, which seems destined to contradict itself continually. He highly commends my controverting false principles, and at the same time blames me for doing so. In a periodical intended to disseminate true principles, the expediency of refuting false ones is obvious; and it is highly probable that the papers of no writer to any periodical work contain such numerous mistaken notions as those of Mr. Wynn. I think it will be allowed that I have shown those I have answered to be chiefly composed of false principles and erroneous positions; and those which remain are not a whit more correct than those which have been examined. Are the errors in them then to pass without refutation, and be palmed upon your readers for truths? Certainly not. The manifest purport of the "Mechanics' Magazine" being to elicit useful truths by discussion and controversy, it cannot deviate from its steady course at the mere suggestion of an anonymous correspondent. I allow that the debate, as it respects church-clocks, is becoming stale; and I regret that there should have been occasion to continue it so long: but as the arguments frequently turn upon general principles, the discussion of other subjects is consequently introduced. And as it is one of those episodes which your correspondent has chosen as the theme of his criticism, he should not have saddled clock-work with the whole burthen. In showing the falsity of a few more of Mr. Wynn's statements, I assure him I will be as brief as I possibly can; and this being done, I promise him I will not speedily trouble him again with any long discourse respecting clock-work. Were he to notice the tenacity with which Mr. Wynn continues to insist on *having* "*practically*" *effected what is impossible to be done*, I am sure he would not think me at fault in exposing such delusion: indeed, Mr. Wynn's extraordinary pretensions of having "annihilated the whole of the friction of the dial-works," is quite unaccountable. For if, on the one hand, we should suppose him to reckon on the credulity of those who do not understand the matter; we cannot, on the other hand, conclude but that he must be aware of its being well known amongst mechanics, and by

* If the medium opposed no resistance, the velocity acquired by a falling body in one second would be 32·167 feet, since in falling it would traverse half that space by a motion beginning from nothing. Hence

$$32{\cdot}167 \times 32{\cdot}167 = 1034{\cdot}16 - 32{\cdot}167 = 1002{\cdot}55$$

In inches

$$386 \times 386 = 148996 - 386 = 148610.$$

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almost every person having any knowledge of machinery, that *it is utterly impossible to annihilate friction even in the simple motions of only two wheels working together*, and much less in a complication of wheels and spindles. I am, &c.

JAMES HARRISON.

Barton-upon-Humber,
Sept. 8, 1829.

P. S.—As none of your correspondents have given any idea that *the same momentum* may produce *extremely different effects*, it is my intention to give such a display in an early Number.

EFFECT OF DIFFERENT WINDS ON THE COLOURS OF VAPOURS.

Sir,—In the No. 340, for Saturday, the 13th inst., of your instructive and entertaining publication, the "Mechanics' Magazine," Mr. C. Hayter is kind enough to endeavour to account to me for the apparent difference of colour (which in one of your previous Numbers I stated that I had observed) in the atmospheric medium, *vulgo* air, when the wind blew from different points of the horizon. My question was, whether any of your correspondents had observed the fact? Mr. Hayter does not reply to this, but proceeds at once to explain the cause. Mr. Hayter first attributes it to the reflection of the rays proceeding from a coloured object placed, as regards the surface of the hill looked against by the observer, at an angle equal to that which a line from his eye would form on the said surface; the supposition being that the slope of the hill is 45°, and line of spectator's vision horizontal. The object seen by reflection would then be perpendicularly over the hill; but take any angles, the reflected ray will always form two sides of a triangle, and the direct ray from the eye to the object the third side of the triangle; therefore the object would be nearer and as visible by the direct view as by the reflected, and no deception would arise. Mr. Hayter, however, admits that there must be a coloured object, and that if there could be no coloured reflection. Now, why is this colour uniformly of some shade of red with an east wind, and as uniformly blue with a west, whether the sky be overcast with clouds or perfectly clear? Mr. Hayter talks of the *density* of the medium as a cause. But if a piece of pure crown glass, (denser than any air) having both sides perfectly parallel and well polished, be placed between the eye and any distant object, no prismatic refraction will take place, and consequently no change of colour. Denseness is, therefore, *not* the cause; and I believe, though I have not *sufficiently* observed the fact, that the barometer has sometimes been low and sometimes high, with an east wind, without affecting the red or roseate hue observable with that wind. I have read something of Sir Isaac Newton's explanation of the cause of the blueness of the sky and redness of the clouds, and also of Mr. De la Hire's explanation of the same phenomenon; and "who shall decide when Doctors disagree?" But even adopting either of their explanations, it would remain to be shown *why the hue varies with each change of wind.*

I believe that in experiments on atmospheric electricity it has been found that with an easterly wind a greater quantity of electrical fluid is to be collected from the air than in any other wind. May not this cause a different form, and also a different relative position and distance from each other of the particles of vapour always floating in the air, and, consequently, a different refraction and reflection of the rays of light: directing, according to their form or position, sometimes the red and sometimes the blue rays, nearer to the earth? I leave it to wiser heads than mine to account for this effect. I think I could convince Mr. Hayter—if he would but leave the smoke of Cirencester-place for the purer air of the country around the town of Cirencester itself (near to my abode) —that this effect may be observed without looking against a hill, and that a large quantity of air may any where be looked through by a horizontal line of vision, though no object terminated the view. I do not wish for publicity, and as I make no offensive remarks, I need only sign, as before,

A. W.

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SOLUTIONS OF THE ALGEBRAIC QUESTION, NO. 316, p. 13.

By Mr. J. Gilbert, Jun.

Sir,—Agreeably to your request, signified vol. xii. p. 285, I now subjoin my solution of the algebraic exercise, p. 13, in an abridged form, and am, Sir,

Yours, &c. J. GILBERT, Jun.

Since $e^2 = \frac{a^2-b^2}{a^2} \therefore n = \frac{a^2-b^2}{a}$, and $q = \frac{a^2-b^2}{b} \therefore \left(\frac{m}{n}\right)^{\frac{2}{3}} + \left(\frac{p}{q}\right)^{\frac{2}{3}} = \left(\frac{ma}{a^2-b^2}\right)^{\frac{2}{3}} + \left(\frac{pb}{a^2-b^2}\right)^{\frac{2}{3}}$

By the first equation reduced $m = x - \frac{}{a^2}(a^2-x^2) - \frac{b^2x^3}{a^4}$. And by the second $p = \frac{(a^2-x^2)^{\frac{1}{2}}}{ab} + \frac{b.(x^2-a^2)}{a^3}(a^2-x^2)^{\frac{1}{2}} \therefore \left(\frac{ma}{a^2-b^2}\right)^{\frac{2}{3}} + \left(\frac{pb}{a^2-b^2}\right)^{\frac{2}{3}} =$

$$\left\{\frac{ax - \frac{x}{a}.(a^2-x^2) - \frac{b^2x^3}{a^3}}{a^2-b^2}\right\}^{\frac{2}{3}} + \left\{\frac{\frac{b.(a^2-x^2)^{\frac{1}{2}}}{ab} + \frac{b^2(x^2-a^2)}{a^3}(a^2-x^2)^{\frac{1}{2}}}{a^2-b^2}\right\}^{\frac{2}{3}}$$

$$= \left\{\frac{ax}{a^2-b^2} - \frac{x.(a^2-x^2)}{a(a^2-b^2)} - \frac{b^2x^3}{a^3(a^2-b^2)}\right\}^{\frac{2}{3}} + \left\{\frac{(a^2-x^2)^{\frac{1}{2}}}{a(a^2-b^2)} + \frac{b^2.(x^2-a^2)}{a^3(a^2-b^2)}(a^2-x^2)^{\frac{1}{2}}\right\}^{\frac{2}{3}}$$

Bringing the terms included within the first pair of parentheses to equivalent terms, having the common denominator $a^3(a^2-b^2)$ their value may be readily found $= \frac{x^2}{a^2}$

And in a similar manner the sum of the terms contained within the second pair of parentheses may be found $= \left(\frac{a^6 - 3x^2a^4 + 3x^4a^2 - x^6}{a^6}\right)^{\frac{1}{3}} = 1 - \frac{x^2}{a^2}$

This is the last of the two expressions, the sum of which $= \left(\frac{ma}{a^2-b^2}\right)^{\frac{2}{3}} + \left(\frac{pb}{a^2-b^2}\right)^{\frac{2}{3}}$; the first of them has been shown $= \frac{x^2}{a^2} \therefore \left(\frac{ma}{a^2-b^2}\right)^{\frac{2}{3}} + \left(\frac{pb}{a^2-b}\right)^{\frac{2}{3}} = \left(\frac{m}{n}\right)^{\frac{2}{3}} + \left(\frac{p}{q}\right)^{\frac{2}{3}} = 1 - \frac{x^2}{a^2} + \frac{x^2}{a^2} = 1.$

Q. E. D.

By Δ (the Proposer)

Sir,—It is some years since I *worked out* the equation to the ellipse; but I have gone through the work again, and I must allow there *is some meaning* in your mathematical friend's "smile" (p. 285, vol. xii.) But yet I think any one who has been through the first part of Algebra, and as he went exercised himself well in the *application* of its rules to the reduction of complex quantities and equations, would not find the "Exercise, No. 316," a very great stumbling-block. I send you the work at length and also the principal steps in the operation, and am yours, &c.

Δ.

[Δ's solution is a very complete one, but as it agrees with that of Mr. Gilbert, we shall content ourselves with giving his statement of the principal steps in the operation.]

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The first object is to reduce each equation to as simple a form as possible, but so that each shall contain the term $\frac{a^2-b^2}{a^2}$ for which e^2 is to be substituted. The equations in this state are,

$$m = a^2 - \frac{\frac{a^2-b^2}{a^2} \cdot x^2}{\frac{ab}{\quad}} \times \frac{-bx}{a} + x$$

$$p = \frac{(a^2-b^2) \cdot (a^2-x^2) \cdot (a^2-x^2)^{\frac{1}{2}}}{a^3 b}$$

Having in each equation substituted e^2 for $\frac{a^2-b^2}{a^2}$ and made farther reductions, we have,

$$m = \frac{e^2 x^2}{a^2} \text{ and } p = \frac{e^2}{ab} \cdot (a^2-x^2)^{\frac{3}{2}}$$

from which last we have $\left(\frac{p.ab}{e^2}\right)^{\frac{1}{3}} = a^2 - x^2$. Now substitute for x^2 its value $\left(\frac{a^2 m}{e^2}\right)^{\frac{1}{3}}$ which is obtained from the equation $m = \frac{e^2 x^2}{a^2}$ and we shall have, after transposing and dividing by a^2, $\left(\frac{pb}{a^2 e^2}\right)^{\frac{1}{3}} + \left(\frac{m}{ae^2}\right)^{\frac{1}{3}} = 1$, and hence, substituting n for ae^2, and q for $\frac{a^2 e^2}{b}$, we have the final equation,

$$\left(\frac{p}{q}\right)^{\frac{1}{3}} + \left(\frac{m}{n}\right)^{\frac{1}{3}} = 1.$$

NEW MATHEMATICAL QUESTIONS.

Prove from principles contained in the first book of Euclid, that the equilateral triangle described upon the hypothenuse of a right-angled triangle is equal to the two equilateral triangles described upon the other two sides.

H. T.

Disect any rectilineal figure, so that the parts may be so joined as to form a square.

ZENO.

There is a mountain in the north of Europe, whose perpendicular height above the level of the sea, is 5420 feet; from the top of which, when the sun's declination is 22′ 50″ N. and on the meridian below the pole the lower limb is just in contact with the horizon. Required the latitude of the mountain, supposing the correction for sun's diameter, refraction and parallax is 16′ 52″, and the diameter of the earth 7956 miles.

AMICUS.

Given the inclination of a cylinder of Archimedes' screw to the horizon, and the diameter of the cylinder: To find the vertical distance between two threads of the coil or pipe, so that water may just be raised by it to the top.

Κρονος.

If three points in one straight line be alternately joined with three points in another straight line, their points of intersection will be also in a straight line. Demonstration required.

G. C.

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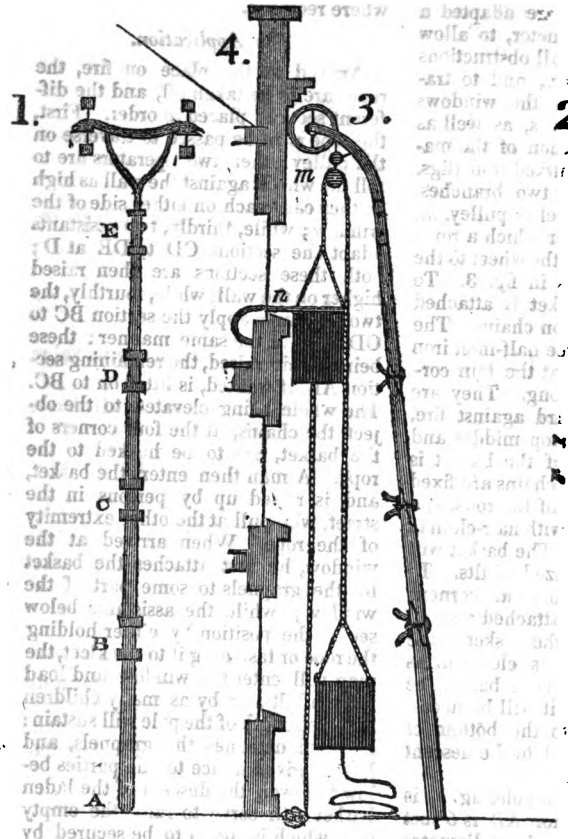
IMPROVED FIRE-ESCAPE.



Sir,—I send the plan and description of a machine for facilitating escape from houses on fire, and for other purposes, which if deemed worthy of insertion among the articles in your Magazine, I submit for public benefit.

Fig. 1, represents a pole of escape, 35 feet 1 inch in length. Fig. 2, a section of the pole. Fig. 3, the sections of the pole placed with its apparatus against fig. 4, a section of a house on fire. Fig. 1, is a pole sufficiently long to reach to the top of any common attic story, divided at its sections obliquely, as shown in fig. 2. These sections are joined at BCD by diagonal adaptation, as represented in fig. 2. The small ends FF of the splice are tipped with iron. Two bands of iron GG, serve to keep the ends FF in their proper places. The upper and lower extremities are protected by an iron shoe, that fits, above and below, into an iron socket, formed out of a band of iron that tightly surrounds the wood. The various sections are firmly fastened by a half-inch bolt, and a screw. Into the section DE a bar of iron, 2 inches wide by 5-8ths of an inch thick, is strongly fixed edgeways, towards the wall of the house, by iron bands and rivets; it is curved shortly after its egress from the wood, as represented by fig. 3, and, at a foot distance, spreads into two arms,

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as represented by fig. 1. The extremities are joined to a curved axle, 4 feet 8 inches long, from wheel to wheel. To the arms are adapted a wheel, 15 inches diameter, to allow the apparatus to clear all obstructions from window-sills, &c., and to traverse on each side of the windows they are intended to pass, as well as to facilitate the elevation of the machine. Where the curved iron (figs. 1 and 3) spreads into two branches, there is a grooved wheel or pulley, *m*, 7 inches diameter, over which a rope, twice the length from the wheel to the ground, is passed, as in fig. 3. To each extremity a basket is attached by slight but strong iron chains. The basket is made of three half-inch iron rods, which are bent at the four corners, to form an oblong. They are made of iron, to guard against fire, and are placed at the top, middle, and bottom; the bottom of the basket is wood. The four iron chains are fixed to the angles of each of the rods, and the whole is covered with hair-cloth to prevent combustion. The basket will contain two middle-sized adults. To each basket at the two inside corners, towards the house, is attached a small grapnel, *n*, to secure the basket to the window at which it is elevated, as shown by fig. 4. If both baskets be used simultaneously, it will be necessary to fix a rope to the bottom of each, in order to regulate the descent of that which is loaded.

The scantling of the pole, fig. 1, is as follows: The section AB is 5 feet 4 inches long, 4 inches by 3 diameter at the bottom A, tapered away to 3 inches and a half by 3, at B; the second section BC 4 feet 10 inches long, 3 and a half at B, tapered to 3 inches at C; the third section CD 5 feet 8 inches long, tapered from 3 inches and a quarter at C to 3 at D; the fourth section is 16 feet long by 3 in diameter in its whole length. Into the foot of AB is fixed an iron spike to prevent the slipping of the machine, and a little above, a wooden kleet, to ease the descent of the basket, or to retain it in any situation. The bolts and screws are marked and fastened to the wood at the sections where they are wanted; the whole apparatus may be packed and bound together by the rope, which is to serve for the ascent and descent of the baskets, and may be transported on its own wheels where required.

The Application.

Arrived at the place on fire, the ropes are to be taken off, and the different sections placed in order. First, the rope is to be passed to traverse on the pulley; then two operators are to roll the wheels against the wall as high as they can reach on either side of the window; while, thirdly, two assistants adapt the sections CD to DE at D; both these sections are then raised higher on the wall; while, fourthly, the two assistants apply the section BC to CD at C in the same manner: these being again raised, the remaining section AB, if wanted, is fitted on to BC. The whole being elevated to the object, the chains, at the four corners of the basket, are to be hooked to the rope. A man then enters the basket, and is raised up by persons in the street, who pull at the other extremity of the rope. When arrived at the window, he first attaches the basket by the grapnels to some part of the window; while the assistants below secure the position by either holding the rope or fastening it to the kleet, the man will enter the window and load it by adults, or by as many children as the strength of the pole will sustain: he then detaches the grapnels, and having given notice to the parties below to lower, the descent of the laden basket will serve to raise the empty one, which is again to be secured by the grapnels till loaded. By this rapid ascent and descent any number of persons may be rescued, without encountering the perilous alternative of jumping out of window. This machine is simple, not expensive, may be quickly packed together, when not in use, and, with care, may be preserved for many years; it will occupy little space, and can be put together for use in five minutes. If it be approved, one such apparatus should be attached to a district under the care of a police-officer.

This apparatus may save the lives of persons who are employed in cleaning the outside of windows, or in the conveyance of bricks, mortar, or other

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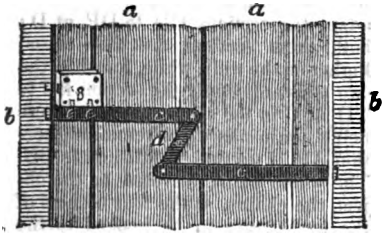
articles, to the upper stories of buildings, or in slight operations, which would require ladders or scaffolding. In this case, if instead of a second basket, a preponderating weight were attached to the other end of the rope, a person may raise or lower himself to any point he chooses. I am, &c.

EDWARD LONG FOX, M.D.

Brislington House, Bristol,
Jan. 8, 1830.

DOOR-LOCK PROTECTOR.



Sir,—Presuming that the contrivance of which I now send you a sketch and description, may be useful to some of your many readers, I beg leave to request a place for it in your pages. I have had it in use a considerable time; and in point of simplicity and security, as a door-guard, I have seen nothing equal to it.

I am, Sir,
Your obedient servant,
BRACKSTONE.*

Avonside, Bristol.

Description.

aa represents the back of the door to which the fastening is to be applied. *bb*. The door-posts. *cc*. Two short iron-bars, connected one to each end of the cross-bar *d* by two pins, so as to make a moveable crank, something like the connecting piece of brass at the limbs of an instrument for drawing parallels, and with the same movement; this is screwed in the centre to the door so as to allow of a small play. At *ee* are two small iron studs or projections, welded or otherwise fastened to the bar *c*.

Now, it is obvious when a key is put through the key-hole, it must touch the bar *c*, and when turned round must communicate its motion by means of the studs to the bar, which advancing forwards, the motion of the cross-piece forces the other forwards in a contrary direction, so that both bars enter a staple fixed in each door-post, and thus secure the door. I need scarcely add that wards like a common lock may be adapted to it, so as to prevent the possibility of its being opened by any other key.

* The series of papers offered by B. will be acceptable.—EDIT.

LONDON BRIDGE.

Sir,—It gives me great pleasure to see that you have taken up this momentous subject with so much spirit and intelligence. If the citizens of London, and the numerous inhabitants of its vicinity, are not much more blind to their interests than I have ever supposed them to be, they will keep a sharp look out after the remainder of the work to its termination.

So far as the *navigation* is concerned, the plan of the new bridge (of course including the removal of the old one), involves as precious a crop of blunders as ever was sown by any *eminent* men in this country. Your remarks, however, and those of two or three of your correspondents, have rendered the most prominent of them very palpable; and will, I trust, lead to the adoption of timely remedies. But could not the architects of this "*noble* structure" (as its admirers are beginning to call it, notwithstanding its obvious defects), be satisfied with greatly injuring, perhaps ruining, the navigation of the upper river, without, at the same time, doing all they could to render the road-way over the bridge and up to Cornhill incommodious and difficult? Why should they have chosen to make the road-way *descend* from the middle arch to Thames-street, and then *ascend* with comparative abruptness, from Thames-street to Cornhill?

Perronet, or almost any of the scientific continental architects, would have carried on the road-way with a gradual and gentle ascent from the middle arch to Cornhill. So would any respectable Scotch architect, if the work were carrying on at Edinburgh, Glasgow, or Aberdeen. Why

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it should not be done in London, except it be that there should be a generous struggle for preponderance between blunders above the structure, and blunders beneath it, I cannot tell.

The late Mr. Ralph Dodd, though by many he was regarded as a wrong-headed man, was notwithstanding a man of talent and ingenuity. In his various schemes for the improvement of the port of London, he proposed *three* plans for bridges across the Thames, in place of the Old London Bridge. In one of these, he proposed that the structure should have *three* arches, in another *five*, in a third *seven*. It is not my present business to describe either of these. I simply beg leave to call your attention to one or two of his hints relative to the *road-way*. Thus, in one of his reports, dated November, 1798, he says, "From the considerable height of this (the proposed new bridge) above the present, it will be necessary for further dry arches on each shore, to prevent too acute an incline of plane in passing the bridge; the hand of nature agreeably presents us with more assistance on the north shore, from the formation of Fish-street-hill, which would enable us to pass from thence to its centre, on a perfect horizontal line, if it were necessary. The communication between Upper and Lower Thames-street, will be kept uninterrupted by means of a dry arch being left open for that purpose; on the Borough side, or south shore, there will be also a necessity for dry arches, to continue the passage from the bridge with an agreeable declivity. The whole of these dry-arches and vaultings need not be without their use for other purposes, as well as the bridge accommodation, as their extensive space might be converted into warehouses for various purposes." In another report published in 1820, he again recommends the consideration of either a horizontal, or a very gently sloping road-way from Grace-church-street, to the middle of the new bridge, and thence "with an easy gradual plane descending in a straight line on the east side of St. Saviour's. The easy transit of such new bridge, from the bottom of Grace-church-street, or East Cheap, would be like that from the Strand to the Waterloo Bridge, nearly a straight horizontal plane."

It is generally understood that the Messrs. Rennies are very far from being unacquainted with Mr. Dodd's various proposals for bridges over the Thames. Why, then, have they overlooked the obvious advantages of that portion of his plans which I thus make known to your readers?

I am, Sir,
Yours, &c.
A RETIRED ARCHITECT.

March 2, 1830.

P.S.—I am aware that in the plan now acting upon for the approaches to the new bridge, it is intended to connect Upper and Lower Thames-street by a dry arch under the road-way from the bridge itself. But that, it is evident, is only one part, though a very essential one, of what a due regard to convenience would suggest. The practical objection which is allowed to remain (so far, at least, as one can judge from present appearances), is, that notwithstanding all the discussion there has been about the approaches, the slope from Thames-street to Cornhill will be *considerably* greater than it would have been had there been one continuous plane from the middle of the bridge, instead of a descent to be succeeded by a proportionally more abrupt ascent.

THE THAMES AND LONDON BRIDGE.

Sir,—The government has not been inattentive (though perhaps you will say it has reserved its parental watchfulness for the eleventh hour) to the dangers which you have so forcibly pointed out, as likely to be apprehended from the demolition of the Old London Bridge. Captain Bullock, an officer of great experience in surveying, has been lately appointed by the Lords of the Admiralty, to make a complete survey of the Thames from above London Bridge to its junction with the sea, and to inquire particularly into the probable operation of the removal of the Old Bridge on the navigation of the river. The Corporation of London too, being

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equally alive with government to the importance of the task entrusted to Captain Bullock, have given directions to all their officers who have any thing to do with the river, to furnish him with every facility in their power. I have no doubt that in the course of a few months we shall be favoured with the result of Captain Bullock's labours, and should they confirm what you say with respect to the necessity of preserving the dam at London Bridge, there will yet be plenty time to have that done.

I am, Sir,
Yours, &c.
J. U. S. C. R. N.
February 26, 1830.

[We heard that government was getting at last alarmed—the Corporation too; and believe Captain Bullock to be as well qualified an officer as could have been selected for a business of this description. But what necessity is there for a survey at all? A survey, especially of the *whole river*, from its sources to the sea? What can Captain Bullock report to his masters on the subject, beyond what they have been already told over and over, by Telford, Gregory, and others? Or may find in "Smeaton's Reports," and "Hutton's Tracts? Or may learn at the Trinity House, where we believe, every thing really useful is known about the tides, not only as far as the Nore, but along the whole coast of Britain?

The idea of first ascertaining how the tides flow at the North Foreland, before coming to any determination with respect to their operation at London Bridge, seems about as wise as it would be in an inhabitant of Cornhill or Bishopsgate-street, not to give directions to sweep the snow from his door until he had ascertained the state of the roads down to Colchester or Ipswich. We suspect that a desire of preserving the credit of the government for foresight—a silly wish to make it appear that whatever is *now* done is the result of new information of their own seeking and obtaining—has had as much to do with this appointment of Captain Bullock, as any thing else. The only new information that we know of as being really wanted, or at least desirable, on this subject, is a moderately accurate estimate of the quantities of water conveyed *upwards* every quarter of an hour through London Bridge during the rising tide, and *downwards* every quarter of an hour during the ebb tide, and that at spring and neap tides, and about midway between. If Captain Bullock will but furnish such a table as this, he will perform an essential public service.—Ed. M. M.]

CAST-IRON BRESTSUMMERS.

Sir,—I am glad that I was not mistaken when I stated that I was convinced Mr. Baddeley would be amongst the first to give my hints respecting brestsummers, &c. his consideration. He still, however, doubts whether any fire, which the cast-iron brestsummers he has noticed are likely to encounter, will be sufficient to heat them to such a degree as to cause them to crack, should water by any means be thrown upon them. This is indeed surprising, as I am convinced that he must be well acquainted with the heat that is produced by a fire in a shop or warehouse filled with combustible materials; and the surprise ought not to be the less when he tells us in the same paragraph that iron will *greedily absorb caloric*.

Now I think we have sufficient facts to prove the necessity of ascertaining how far the strength of iron, whether wrought or cast, is affected by heat before either is again used, without protection, as a security against fire. Let us suppose a warehouse, filled with combustibles, over which is a floor constructed upon Mr. Farrow's patent, will not his iron joists get red-hot? And if so, their strength will be so greatly reduced as to render them incapable of supporting the contents of the upper room; or if that be also filled with combustibles, the red-hot iron joists will set them in a blaze.

I remain, Sir,
Yours respectfully,
J. C. S.

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MATERIALS OF BUILDINGS.

Sir,—One of your indefatigable contributors has expressed his approval of the sentiments I offered respecting the utility of, and necessity for, certificates of the materials and workmanship of which houses are composed. But however desirable such documents may be, before they are ordered by law, much more must be said on the subject—I therefore call upon those of your readers who may have any ideas, either in favour of or against such a proposition, to lose no time in communicating them to you.

In the mean time I beg to trouble you with the accompanying paper.

Yours, &c. C. D. S.

New Building Act.

That much more may be done by Parliament to reduce the risk from fire in our domestic dwellings without much, if any, increase of their cost, is to me quite evident. This is to be done by constantly adhering to the practice of never using a combustible material in any situation where an incombustible substitute may be obtained. Wherever wood is now used, for example, in consequence of its cheapness in preference to brick, though brick in every other respect is equally if not more applicable, let the duty be taken off.

Every nerve ought now to be exerted to obtain the most effective means of preventing the loss of life by fire. Many of the persons who have thus been sacrificed, have suffered for the pecuniary advantage of speculative individuals. We have only to look around us, and be satisfied that in this great city abundant preparations are made in every direction for conflagration and sacrifice; and let every individual who may behold these appearances with indifference, reflect upon this—that it is not impossible but he may lose some dear friend, or even his own life, at some time or other by fire. But it is not the direct loss of life by fire only that demands our attention; there are the broken limbs, bruises, frights, and mental sufferings—one or other of which accompany every conflagration, and, doubtless, frequently lead to protracted indisposition, decrepitude, and death.

Sixty-two years ago the humane and benevolent Dr. John Fothergill testified that much personal injury was frequently occasioned by the terrible alarm of fire by invalids and females; and, doubtless, almost every medical gentleman now in London could furnish some facts of the same nature.

It would be desirable to know what arguments were used to induce the legislature to make the present Building Act. It is only reasonable to suppose that all the plans then proposed were not introduced. Perhaps some hints, which would now be deemed valuable, were overlooked. Some of Dr. Fothergill's thoughts were published in 1768 and 1769, on this subject in the Gazetteer; but it is not to be supposed that he was the only person in that day prompted by humanity to advocate the necessity of additional security from fire.

I avail myself of a few of the ideas of Dr. F.; only adapting them to the present time and circumstances.

Ought a well-governed *country, especially in large towns with lofty houses*, to permit any such buildings to be erected as may be attended with such dreadful consequences? Most certainly it *ought* not.

Shall families be stripped of their support—shall the public be deprived of useful members—shall distress and ruin be spread through a neighbourhood without an endeavour to prevent *entirely* the like inconvenience in future? Humanity, at least, speaks another language. Perhaps hearts obdurate to every other sensation, but that of gain, would pass through the ruins of the metropolis itself without a sigh or a wish for the prevention of such fatal accidents.

Such were the sentiments of Dr. Fothergill.

In conclusion, I would repeat, if the duty upon brick or any other incombustible materials enhances their price so as to induce builders to use inflammable materials instead thereof, that duty ought to be removed. So long as it remains it is a tax upon safety of life.

C. D. S.

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VELOCITY ON RAILWAYS.

Sir,—If my good friend, S. Y., (an engineer) will show that the quantity of mechanic force which is sufficient to maintain a definite velocity in a body (either subject to friction or not) is insufficient, without the aid of extra power, to procure that velocity; and that whether that velocity be or be not attained, it is not a compound question of inertia and friction; and that the absurdity of *The Scotsman's* assertion, (taken in the sense in which S. Y., a young engineer, has quoted it at p. 68, vol. viii.) "that, speaking practically, it would cost no more to command a velocity of 20 miles an hour on a railway than a velocity of one," is not abundantly proved by showing the limiting velocity which a certain expenditure of power will maintain in an unresisting medium; or if he will without tergiversation demonstrate that friction (which I have always been taught to believe to be of a retarding nature, but which idea, perhaps my friend S. Y. will be able to dislodge) will cause a body in motion to attain a greater velocity than where there is no friction—why then I will concede to him that my communication has nothing to do with the question.

As to "the methods of proof pursued by your correspondents," seeing that I had not then read the early parts of the discussion, nor the article from *The Scotsman*, perhaps S. Y., an engineer, will have the goodness to say whether the communication at p. 212, vol. viii. be or be not sufficient to lead to the opinion I had formed. If he thinks not, he will oblige me by showing what the ingenious author of that article has done, other than substituted figures in well-known expression for the motive force

$$(i.e.)\ \mathrm{M} = \frac{v}{t}\mathrm{W}.$$

I admit that my last communication has nothing whatever to do with the question of "the quantity of mechanic force equal to the resistance caused by friction," in the sense used by *The Scotsman*; but it has about as much to do with it as that at p. 358, vol. iii., for—after [illegible] has been written against the unfortunate article from *The Scotsman*, and which, on attentive perusal, I incline to think has been much misunderstood—I would ask what will be the difference in result of S. Y.'s "comparative statement" as to the merits of the railway and canal system, and *The Scotsman's*.

I am, Sir,
Yours respectfully,
R. C., JUN.

QUADRATURE OF THE CIRCLE.

Sir,—I have an old mathematical manuscript by me, in which it is asserted that the sum of the series $1-\frac{1}{3}+\frac{1}{5}-\frac{1}{7}+\frac{1}{9}-\frac{1}{11}+\frac{1}{13}-\frac{1}{15}$, &c. &c., to infinity, is equal to the area of a circle whose diameter is one. Is this correct—and if so, is it generally known? I have always understood that the usual method of squaring the circle, as it is termed, has been by bisecting or trisecting an angle; but if the above is correct, it must be a much shorter and easier way.

I should not have troubled you with this question, but being myself only a journeyman mechanic, my means will not allow me to procure books, either to acquire knowledge or satisfy curiosity.

Excuse me, sir, for adding what follows, as it proves the truth of the old adage, "never too old to learn." I had arrived at the full age of manhood, without knowing more than I had learned at school in my boyish days; viz. reading, writing, and the four first rules of arithmetic, when, principally through reading some articles in your Magazine, I was determined to understand something more of mathematical subjects. My circumstances, above alluded to, prevented me from getting instruction, but I applied my mind to the work, and by the help of three old books, —Walkinghame's Tutor's Assistant, Fenning's Guide to Algebra, and Sir Jonas Moore's Mathematical Compendium—the last of which, I purchased at a book-stall, in London, for eight-pence—I have made myself master of arithmetic—understand algebra as far as the solution of quadratic equations, and the rudiments of

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geometry and trigonometry, which is as far as my present library leads me; but it is my intention to purchase the mathematical parts of the "Library of Useful Knowledge," which I hope will enable me to proceed further.

I have taken the pains to find the sum of the above series (by the only method which I know) as far as the 2855th term; viz. as far as the term $-\frac{1}{5711}$ and find the value of it up to that term, inclusive, to be = .785319962 + &c. &c. The difference between this and the area of a circle, whose diameter is 1, is only .00008; and the further the series is proceeded with, the nearer the approximation will be. At all events, if this series is not equal to the said area, it is singular that it should approach so near to it.

When I commenced the tedious task of trying to prove the truth or falsehood of the above assertion by finding the sum of the series, it struck me that I could avoid the number of subtractions occasioned by the negative signs, and thus shorten the work by converting the series into one of equal value, where all the signs should be positive—as follows. It is evident that $1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} - \frac{1}{11}$ &c. &c. is equal to $(1-\frac{1}{3})+(\frac{1}{5}-\frac{1}{7})+(\frac{1}{9}-\frac{1}{11})+$ &c. &c., and by converting each of the pairs of terms, having the negative sign between them, into one by subtraction, the series will become $= \frac{2}{3} + \frac{2}{15} + \frac{2}{63} + \frac{2}{143}$, &c. &c., or in decimals as follows, .66666666 + .057142 85 + .02020202 + .01025641 + &c. &c., up to the pair of terms $(\frac{1}{5709} - \frac{1}{5711}) = \frac{2}{32604099} = .000000$ 061, &c., and the sum of all the terms, (up to this) is as above stated = .7853 19962, differing from the true area of a circle whose diameter is unity by about .00008. In the second series $\frac{2}{3} + \frac{2}{15}$ &c. &c., the terms are all positive, and four of them are equal to eight in the original series.

I should like to know if there is any more compendious way of finding the sum of such a series as the above; I do not think there is any rule, either in arithmetical or geometrical progression, applicable to it.

I am, yours, &c.

T. F. M.

Woolwich,
November 16, 1829.

[Our ingenious correspondent asks if the statement is "correct;" that the sum of the series, $1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9}$ &c., is equal to the area of a circle whose diameter is 1? It is so; and any one who can find the exact sum of that series—a thing never yet done, and by some supposed to be impossible—will then have found out the exact quadrature of the circle. Several other forms of series have been devised for expressing the ratio between a circle and the circumscribed square; but none of them has led to any nearer approximation to the truth, than the one here quoted (which was found out by Leibnitz and Gregory). The mechanical methods of "bisecting" and "trisecting" alluded to by our correspondent, can be of no avail in a case of this kind, where the solution is only to be found out (if ever) by equations of indefinite degrees. It is but just to our correspondent to add, that considering the great disadvantages he appears to have had to encounter, his letter does him infinite credit. It presents at once a striking example of persevering ingenuity in humble life, and a valuable testimony to the stimulating influence of our little work on the minds of its readers.—ED. M. M.]

MINOR CORRESPONDENCE.

Mr. Carter's Patent Cast-Iron Roofing is certainly an excellent invention; but as in the description of it in your 224th No. he has not stated how it can be used with *hipped* roofs, I should be much obliged to him, or to any of your other Correspondents who would state some method whereby it might be employed in every variety of that description of roof.

March 2, 1830. PAT.

Sir,—Permit me to refer "An Amateur Turner," p. 344, to p. 94 of your 5th volume, where he will find an improvement on the instrument for taking patterns of mouldings, &c. in no material point different from his own, at any rate his senior by upwards of *four years*.

Yours, respectfully,

WM. BADDELEY.

MISCELLANEOUS.

Improved Clock.—Mr. Walter M'Adam, watchmaker in Bathgate, has lately constructed an 8-day clock on an entirely new principle. The clock has only one barrel, and both goes and strikes the hour by the impulse of a single spring. The contrivance is exceedingly ingenious, and, at the same time, very simple; so simple, indeed, that one wonders, after seeing it, how the idea had never occurred before.—*Stirling Journal.*

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Sailing on Railways.—It appears from the following paragraph in a Baltimore paper, that an attempt is making in America to revive the application of sails to the propulsion of carriages on land:—"An experiment was made yesterday (Jan. 27) on the rail-road with a carriage propelled by a sail. The management of the sail was confided to a shipmaster of great experience; and on the return of the carriage before the wind it went at the rate of 20 miles an hour. Although the check was freely used, and the sail afterwards struck, the impetus was so great, that the carriage could with difficulty be brought up."

Coal-Mine on Fire.—"About two years since it was observed that the snow falling on a part of the estate of Earl Mansfield, near Stirling, was quickly melted, no matter how low the thermometer might be. This led to examination, when it was ascertained that a seam of coal, at a great depth below the surface, was on fire. Various means having been tried to extinguish the fire without success, it was at length resolved to surround it with a tunnel and strong wall, within which it might burn out. For a year and a half this plan has been persevered in, but as often as the workmen have brought the wall within a few fathoms of meeting, the fire has burst out upon them, and compelled them to take a large circuit. The heat in the tunnel reaches frequently as high as 230 degrees."—*S. D.*

Vision of Birds of Prey.—The toucan is a bird which ranks next to the vulture in discerning, whether by smell or by sight, the carrion on which it feeds. The immense size of its bill, which is many times larger than its head, was supposed to present, in its honeycomb texture, an extensive prolongation of the olfactory nerve, and thus to account for its power of smelling at great distances. But on accurate examination, the texture above-mentioned in the bill is found to be merely intended to give the bill strength. Now, the eye of the bird is somewhat larger than the whole brain; and it has been ascertained, by direct experiments, that where very putrid carrion was enclosed in a basket, from which the effluvia could freely emanate, but which concealed the offal from sight, it attracted no attention from vultures and other birds of prey, till it was exposed to their view, when they immediately recognised their object, and others came rapidly from different quarters of the horizon where they were invisible a few minutes before. Thus, the sudden appearance of birds of prey from immense distances, and in every direction, however the wind may blow, is accounted for by their soaring to an altitude far beyond our sight. In this situation their prey on the ground is seen by them, however minute it might be, and therefore their appearance in our sight is merely their descent from high regions of the atmosphere to within the scope of our optics. The toucan, in India, generally arrives a little in the rear of the vulture, and remains till the larger bird is glutted, while smaller birds of prey, at a still more retired distance, pay similar homage to the toucan.—*Z.*

An Effectual Means of Curing a Cut, Bruise, or Burn, is said to be the inside coating of the shell of a raw egg. Apply the moist surface to the wound; it will adhere of itself, leave no scar, and heal any wound, without pain, more speedily than any salve or plaster in the universe.

Economical Water-Colour for Rooms.—Take a quantity of potatoes and boil them—then bruise them, and pour on boiling water until a pretty thick mixture is obtained, which is to be passed through a sieve. With boiling water then make a thick mixture of whitening, and put it to the potatoe mixture. To give colour, if white is not wanted, add the different-coloured ochres, lamp black, &c., according to circumstances. This paint dries quickly, is very durable, and has a good appearance to the eye.—*French Paper.*

Cultivation of Potatoes.—A French soldier placed half a dozen potatoes at the bottom of a cask, upon a layer of sand and fresh earth, three or four inches thick; when the stalks had risen a few inches, he bent them down and covered them four or five inches deep with the same mixture. He continued this operation until the cask was full. Six or seven months after, upon emptying the vessel (which stood in a court-yard) he found that the half dozen potatoes had produced an enormous quantity of new ones, from the portions of the mother stems, which had been successively laid down and covered.—*Jour. des Connais. Usuelles.*

Animal Weather-Glass.—At Schwitzengen, in the post-house, we witnessed for the first time what we have since frequently seen, an amusing application of zoological knowledge for the purpose of prognosticating the weather. Two frogs are kept in a glass jar about 28 inches in height and 6 inches in diameter, with the depth of 3 or 4 inches of water at the bottom, and a small ladder reaching to the top of the jar. On the approach of dry weather the frog mounts the ladder; but when wet weather is expected, they descend into the water. These animals are of a bright green; and in their wild state here climb the trees in search of insects, and make a peculiar singing noise before rain.—*Mag. of Nat. Hist.*

INTERIM NOTICES.

The Supplement to Vol. XII. containing Titles, Preface, and Index, with a beautiful Portrait on steel of Thomas Squire, Esq., of Epping, will be published on the 31st of March, price 6*d*.

We have received the first part of Mr. Gilman's more particular refutation of the statements of a "Practical Engineer," but not in time for publication this week. It shall have a place in our next.

Communications received from J. S. S.—An Amateur—J. G. Y.—W. H. B.—C. W. C.—No Croaker—L. S.—Equation—Mr. Harris.

Erratum.—Sir, There is an omission in the description of my plan for adjusting the object-glasses of achromatic telescopes in your Magazine for this day, which in practice would render the contrivance useless. After the sentence, "this is screwed upon three brass pillars about one-fourth of an inch high," it should read thus, "*on each of which is a spiral spring. The three screws, &c.*"

I am, Sir,
Yours very respectfully,
JOHN HOLYMAN.

176, *Old Gravel-lane, Feb.* 27, 1830.

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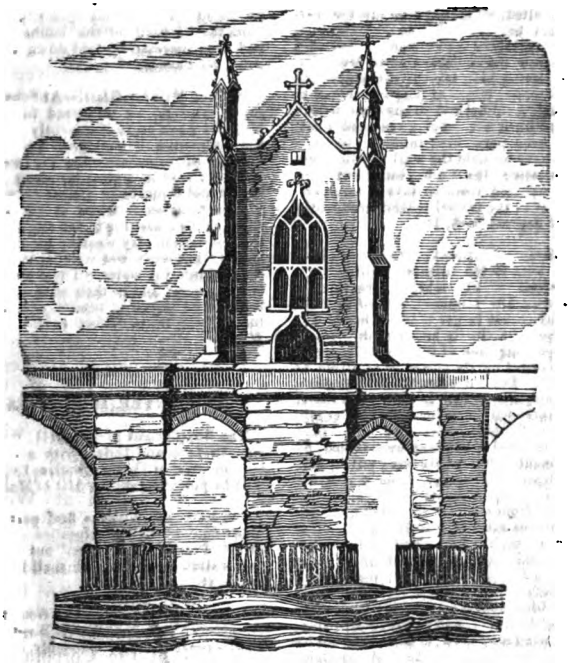
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 344.] SATURDAY, MARCH 13, 1830. [Price 3d.

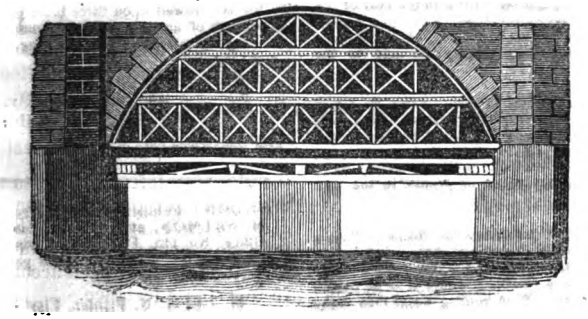
OLD LONDON BRIDGE IN 1209.

Fig. 1.



CENTERING EMPLOYED IN 1750.

Fig. 2.



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DESCRIPTIVE ACCOUNT OF THE PRINCIPAL BRIDGES ERECTED OVER THE RIVER THAMES. BY MR. C. DAVY, ARCHITECT.

No. X.

Centering of the Old London Bridge, 1750.

(Continued from page 3.)

When the builders ceased their operations on Old London Bridge in the year 1209, it exhibited an appearance similar to the prefixed engraving, fig. 1. The architect of the structure had previously been buried in the crypt within the centre pier, over which was a chapel, dedicated to St. Thomas. This subject is so interesting to the antiquary, that I shall not hesitate to introduce the following particulars respecting it from "Brayley's Londoniana:"—

"The fact of the interment of Peter of Colechurch within the chapel upon London Bridge is substantiated by the annals of Waverley. Maitland says, 'in the middle (of the chapel) was situate a sepulchral monument of the length of seven feet and a half, and the breadth four, the remains whereof were lately (1737) discovered by Mr. Yaldwyn, the present inhabitant, when he repaired the staircase which he built over it.' (Vide 'Hist. of Lond.' vol. i. p. 46, by Entick.) But neither in that nor in Maitland's own edition of 1739, is there any mention of Yaldwyn's discovery, 'the remains of a body,' as mistakingly apprehended by the ingenious editor of 'The Chronicles of London Bridge.' We may, therefore, be allowed to conjecture, that if due care be taken when the old bridge is pulled down, as most probably it will in the course of two or three years, the bones and ashes of its venerable architect will still be found."

It was the removal of this chapel, and part of the grand pier, and the building of the centre and largest arch, that formed the chief portion of the extensive alterations in the year 1750. There is a circumstance connected with these alterations which exemplifies remarkably the sort of economy which prevails in Corporation jobs, and may perhaps help to account for the enormous sums which this fabric has cost the public. The expense of the centering of the large arch alone amounted to £1700. The City carpenter received from the Corporation two shillings per foot for the work (including labour), besides getting back the old materials when the centre was removed. The temptation this afforded of cramming as much timber into the work as possible was irresistible; and the consequence was a centering so huge and rude, that it would have disgraced the constructors of a Norman or Saxon era. It was an impudent job, too; for the public had by that time witnessed in the centerings employed at Westminster, Kew, and Walton Bridges, some memorable specimens of the scientific combination of strength with lightness. If the centering employed at London Bridge, in 1750, be compared with that adopted at Westminster Bridge, the contrast is extremely discreditable to the parties employed in the City-works. The centering of Westminster Bridge was the work of the ingenious Mr. James King, and contained only 6500 feet of timber—while that of the Corporation jobber, as represented in fig. 2, contained no less than 17,000 feet of wood. The spans of the different arches were as follows:—

	Form of Arch.
Westminster Bridge, 76 feet	Semicircle, springing from 2 feet above low-water.
Old London Bridge, 70 feet 6 inches . .	Segment, versed sine 23 feet.

The difference in the contents of each is the more surprising, when it is considered that the starlings of Old London Bridge afforded, by their projection in the arches, a space amply sufficient for the ends of the centering to rest on. There was, besides, part of the old pier left standing to support that portion of the centre having the greatest tendency to fall. By a better arrangement a saving of at least £1000 might have been accomplished in this single instance.

The variation of curvature in the

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segment or semicircle, and the semi-ellipsis, will fully justify the introduction of a greater quantity of timber for the purpose of centering in the case of the latter curve. This is principally owing to the vertical pressure of many of the voussoirs at the crown of the arch. It is usual under such circumstances to construct the centering in two distinct parts (see last paper)—one for the flattened part of the arch, the other for the flanks or haunches. On the contrary, in the case of the segment of a circle of large radius, where the force is more equably distributed, the pressure of the haunches approaches nearer to the force exerted at the crown; the arrangements of the centering for one will not answer for the other. Owing to a defect of this sort at the Southwark Bridge, the centering failed at the haunches, but was sufficiently firm at the summit of the arch. Segmental centering of large radius should be at least equally strong throughout; and a saving of timber may be effected by letting the principal pieces tend towards the centre that describes the arc, the whole forming a trussed polygonal figure. It is important also to know, that the voussoirs will begin to slide from their positions at an angle of 30–5°, a fact which naturally directs attention to those parts of the centre requiring the necessary opposing forces. M. Riou's table, although giving a maximum of strength, is still of sufficient practical utility to be here inserted.

Riou's Table for Timber Centering.

Length.	Breadth.	Thickness.
12 feet .	10 inch. × .	12 inch.
15 . .	11	13
18 . .	12	15
21 . .	13	16
24 . .	14	18
27 . .	15	19
30 . .	16	21
33 . .	17	22
36 . .	18	23
39 . .	19	24
42 . .	20	25

(To be continued.)

LONDON MECHANICS' INSTITUTION.

(From a Correspondent.)

At the quarterly general meeting on Wednesday last the number of members was stated to be increased; and it appeared that a little improvement in the finances had taken place. The Report was, upon the whole, satisfactory, but there is ample room for improvement in the mode of managing the affairs of the Institution. The apathy of the Committee was alluded to frequently during the evening by various members. The subject of gratuitous lectures was not forgotten. Some of those during the past quarter, as was truly stated by a Member, were delivered to an audience of not more than fifty persons; and so well was the Committee aware of the value of these lectures, that on those evenings it was a rare occurrence to find three Members in attendance. On one evening, when Mr. Larkin delivered an unfortunate lecture to empty benches, there was not a single individual in the Committee-box. Why, then, are such unpopular lecturers as Messrs. Larkin, * * * * *, and others of the same kind, permitted to appear, unless to show contempt of the Committee for the wishes and feelings of the Members. Whatever may be the acquirements of these gentlemen, they are wholly unqualified for public lecturers. They are deficient in power of expression; their arrangements are confused; and some of the most interesting facts in science are by them communicated in a mode that is wholly unintelligible to the auditors.

That the Members have no apathy in this respect is proved whenever a competent person appears before them. The lectures of Messrs. Wallis, Hemming, and Buckingham, have been attended by crowded audiences, although the subjects treated of by them are not a whit more interesting or important than those introduced by the others. The subject of mechanics, divided between Dr. Birkbeck and Mr. Toplis—in the hands of the former filled the theatre, while the latter seldom had one hundred and fifty auditors. Mr. Hemming, in perhaps the least interesting branch of chemistry, treats his subject so skil-

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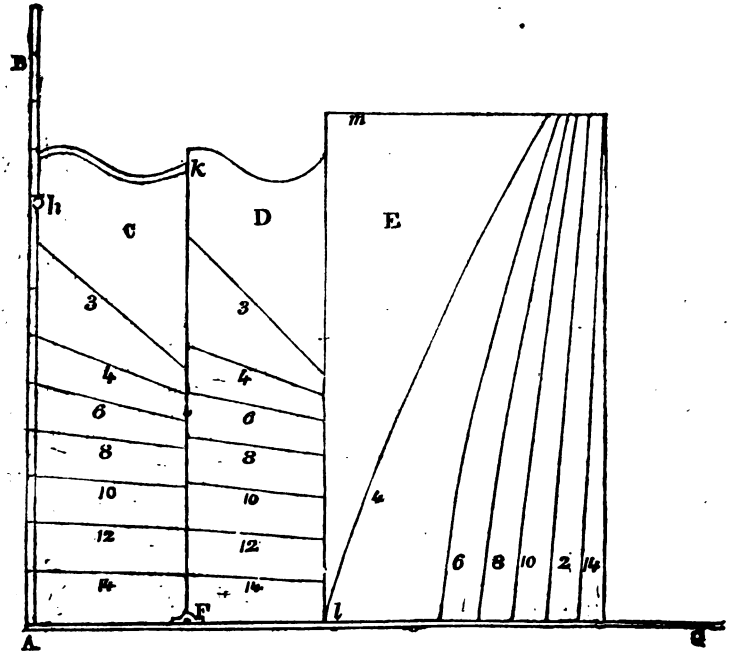
fully, that the house is crowded when he lectures; and Mr. Buckingham, on a subject that appears little likely to attract or interest a mixed assembly, renders it by his talents so popular and delightful, that there is scarcely a seat to be obtained when he commences.

Let the new Committee take warning from the mismanagement of their predecessors. *The Institution may yet prosper;* but it must be by engaging men of talent and eminence to act as instructors to those who are now become too enlightened to endure those who have lately so often and so unwisely been placed before them as teachers.

R. D. G.

INSTRUMENT FOR FINDING THE DISTANCES OF VANISHING POINTS, &c.



Sir,—The instrument which it is the design of this letter to lay before your readers, is only partially exhibited by the above figure. Very few of the lines requisite to be laid down upon it are shown, because a greater number would only tend to embarrass the description, without serving to elucidate in any respect either the principles of its construction or the objects which it is designed to accomplish.

In the above figure, AB is a scale of equal parts vertically fixed at A; the pieces C and D, which are alike in every respect, are connected by a hinge at F; these pieces and the piece E slide freely at bottom in a horizontal groove AG; and the piece C slides freely in a vertical groove cut in AB, and may be fixed in any position by the thumb-screw *h*. When any line on the piece C is brought to coincide with any other line tending to produce with a line coincident with AG a vanishing point, the distance of that point from the most distant point of the contact of that line with the line on C will be shown by the number standing against the line on C.

But as the line will probably not

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coincide with any of the lines that are drawn on C, it will be proper to calculate the positions of a number of other intermediate ones, and write their distances and draw their extremities upon AB, F*k*.

These distances are first assumed, and then their inclinations to the vertical line AB are calculated by plane trigonometry.

And as in a small instrument of this sort a number of these lines may be drawn with properly assumed distances to comprehend nearly all angles of inclination, it is plain that they will serve to find the vanishing point produced by AG, and a line that coincides with any line on the piece C.

The figures 3, 4, &c., on the pieces C and D, denote the distances from AB, measured by a scale of equal parts, where those lines produced would meet AG.

But if the line tending to a vanishing point be distant from AG, it will be requisite to move the piece C in the groove up the scale AB until some line upon C coincides with that line, and then, as the distance up the scale AB of line on C, in first position : the number written against that line : : its distance up the scale when it coincides with the given line : the distance from AB of the vanishing point.

Thus, I think, it will appear, that this contrivance will, in a great measure, accomplish the desideratum, of finding with tolerable accuracy the distances of either near or very distant vanishing points.

And it is obvious, that it will enable us also to ascertain the radii of the dividers for describing any assigned circular meridian on a map.

In the practice of perspective, it is often found necessary to draw several lines from given points in a direction towards a distant vanishing point.

In this case, if the directions of any two lines towards that point are exhibited, the *distance* of that vanishing point will be found by the method already explained; and the directions of the other lines will be found by help of the parts D and E, as follows:—Slide the pieces C and D up the groove in AB until the extremity of the line on D, expressing the distance of the vanishing point, touches the point from which the line is to be drawn; then having made all fast by the thumb-screw, let the piece D turn round the hinge F until the line on D touches a line marked by the same figure on E, the position of the line on D, with respect to AG, will be the slope or direction sought.

The lines on the piece E marked 14, 12, 10, &c., are the loci of the vertices of triangles, having their hypothenuses 14, 12, 10, &c., when one extremity of the base is always in AG or AG produced, and the other in the perpendicular *lm*. These lines are easily found mechanically; they are transferred to the separate piece E, as shown in the figure, merely to prevent confusion.

I am, Sir,
Yours respectfully,
J. G. N.

NEW STREET PROPOSED.

Sir,—On one of the coldest days which we have had this winter, I was induced to pass along those wretched streets between Hart-street, Bloomsbury, and the east end of Oxford-street. The air was then impregnated with a most noxious stench; and I thought, if this be the case in the coldest part of winter, what must it be in the hottest part of summer? No wonder, indeed, that in such situations the most infectious disorders should commence: but the surprise is, that no *general* attempt has ever been made for the cleansing or removal of every pestilential neighbourhood in this great city.

The removal of a great portion of the neighbourhood to which I have referred, would give an opportunity of making one of the grandest improvements, which, compared with the expense, London is susceptible of. On looking to the map it will be seen, that if a street were formed from the east end of Oxford-street to the end of Southampton-street, in Holborn—by such an *union*, Oxford-street and Holborn would form one continuous line. And whether we contemplate such an improvement with respect to the sink of contagion which it would eradicate—the more comfortable and more healthy habitations which many of

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the inhabitants might obtain by removal—the avoiding of the narrow, awkward turning by St. Giles's Church—the general advantage to the neighbourhood, or its forming one of the finest lines to the New Post-office and the City—the benefits to be obtained are all of that character which would reflect the highest credit upon those who may be the means of accomplishing so desirable an object.

In those districts where every room in every house contains one or more families, if the entire removal cannot be easily accomplished, public health would require, indeed the love of mankind ought to be sufficient to stimulate us to repair, ventilate, and cleanse, from time to time, those wretched abodes of the poor. And we have reason to suppose, that besides the public advantages as to health which such a measure would occasion, it would also have a salutary effect on the persons and habits of the lower orders.

Dr. Fothergill, of whom I have before made mention, but with whose ideas I was unacquainted when the former part of this was thought of, exerted his influence "to widen the streets, and open new communications for the *health* and convenience of the citizens." It is stated that he projected the often talked-of new streets from Blackfriars' Bridge in a straight line to Islington, and from the Mansion-House to Moorfields; and that by the exertions of Charles Dingley "it had near been accomplished." Sixty years, however, have since passed away, and no individual or society with sufficient interest or exertion has arisen to carry these manifestly valuable improvements into execution.

Yours, &c.

C. D. S.

TEETH OF WHEELS.

Sir,—No one can more completely coincide with Mr. Harrison's remarks, as far as the period in the fourteenth line of his communication, vol. xii. p. 362, than myself. In respect to his following observations, I must beg to assure him, that I do not "presume on what I have seen in print," but that I consider the true form of teeth is to be found by mathematical investigation *only;* for although *practice* will point out the defects of certain forms, it will not point out the true form. And I certainly *do* presume, that Drs. Gregory, Robison, or Rees, are as good authority in all matters of theory as Mr. Harrison himself; notwithstanding that gentleman seems to think their productions unworthy his attention.

Mr. Harrison says, "as it is much better to be guided by strict matter of fact than merely by what any author whatever may happen to advance, there is no necessity for me to consult the authors he refers to." But does Mr. Harrison expect that we are to receive whatever *he* may "happen to advance" as "matter of fact," merely because he says it is so? The authors I have named condescend to give their readers some *proof* of what they assert. *Why does not Mr. Harrison do the same?*

Mr. Harrison then proceeds to state the friction of epicycloidal teeth; *but I never said these teeth were without friction*, and he may attribute as much to them as he feels inclined. He has already charged them with about twice as much as they are answerable for. I spoke of *involute* teeth. And as to their wear, will Mr. Harrison tell us how they do wear?

The object of my former communication on this subject was merely to make known to such of your readers as felt interested in it, that I thought Mr. Harrison's opinions were not correct; and to point out to them the works in which they might find my reasons for thinking so, and investigate for themselves.

Mr. Harrison seems offended at my not having shown him by what "magic" the teeth I have named work with so little friction. I am sorry I cannot oblige him in this, because there is no magic concerned in the business. But I will endeavour to explain the matter without calling in the aid of the black art; by which alone Mr. Harrison intimates it can be effected. And if I should succeed in making that clear which is at present so incomprehensible to him, I hope he will not hastily conclude, in

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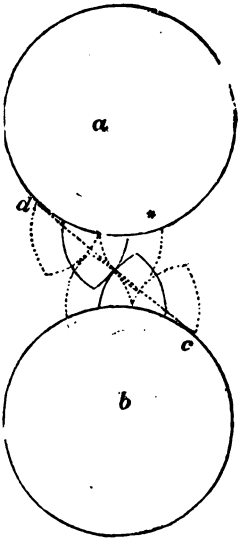
consequence of my doing so, that I have dealings with "spirits of evil."

Now, suppose a thread unlapped from the circumference of the circle *a*. The point of the thread which left the circle at * will have described the dotted line beginning at *, which is the curve of the teeth.



The dotted teeth *c* and * are just beginning to act on each other. The teeth shown by lines are about half way; and the other two-dotted teeth show the position of the teeth when they are about to leave each other.

A very slight consideration of the figure, and the nature of the curve of the teeth, will serve to prove that the teeth act on each other along the line *cd*; and that no part of their surface, except what is *on* that line, is in contact. It will also be observed that the action begins at the root of the tooth *c* and the point of tooth *; and ends at the root of the tooth * and point of tooth *c* when they come into the position shown by the other dotted teeth.

It is also evident that the tangent to the touching surfaces of the teeth will always be a right line to *cd*.

Now, the touching surfaces of the teeth meet on the line *cd*. They both pass over that line in the *same* direction; and with the same or *very nearly* the same velocity. And what is to cause them to slide or rub on each other?

In my last I quoted from memory; I find the passage runs thus, (Robison's "Mechanical Philosophy," art. Machinery) "The whole slide of a tooth three inches long, belonging to a wheel ten feet diameter, acting on a tooth of a wheel two feet diameter, does not amount to one-sixtieth of an inch." Now, if the Doctor had been writing for the purpose of proving a rival Doctor an ignoramus, I might have suspected the correctness of his statement. But he had no such unworthy motive.

Epicycloidal teeth will communicate motion equably. But they will only do this while the centres of the wheels they are applied to are accurately the intended distance apart. And the form of the tooth depending on the size of the wheel, lantern, &c., it is to drive, they will fulfil this condition *only* with one lantern, &c., or several of the *same* size.

They are attended with friction; consequently waste of power, and wear.

Involute teeth communicate motion equably. The form of the tooth depending on the size of its own wheel, *only* wheels with these teeth will drive others of *any* size. They will work equally true, whether deep or shallow in gear.

They have little or no friction; therefore, little or no waste of power, or wear.

Which is the best form, I will leave your readers to decide for themselves.

As Mr. Harrison insinuates that the "epithet" of young is assumed for the purpose of claiming indulgence, I will drop it, and retain only the "title," subscribing myself

Yours respectfully,

S. Y. (an Engineer.)

Jan. 22, 1830.

FARROW'S PATENT WROUGHT-IRON JOISTS.

Sir,—In answer to a query in your last Number, whether my wrought-iron joists would not get red-hot by being exposed to the blaze of com-

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bustible matter contained in a room filled with such material, I have no hesitation in saying that they would not; nor, were one placed over a forge a few inches from the fire, and a constant blaze kept up on one part by the bellows for the space of two hours, would it get red-hot in that time. There can be nothing, therefore, to apprehend from this cause; as even were no efforts made to extinguish the fire, it would exhaust itself long before it could communicate sufficient heat to the joists to endanger the safety of the building.

I am, Sir,
Yours respectfully,
March 8, 1830. BENJ. FARROW.

IMPROVED LAMPS.

Sir,—Few inventions have been presented to us in greater variety than the oil-lamp; its form, its wick, the mode of supplying the oil, the very admission of the air, have undergone improvements to an amazing extent. Still they have their inconveniences, especially those unconnected with a fountain, which suffer a great diminution of light after the oil has obtained a certain level. And the want of a sufficient supply of oil causes the formation of a large portion of carbonaceous matter on the wick, as also a dull, smoky flame. To keep up an equable supply of oil without adding a fountain, is the object of the two plans which I now transmit you.

I have long thought that the Indian-rubber bottles might be applied as in fig. 2, where one of them appears inclosed in a metal ball; the neck of the bottle is secured to a broad ring, containing the wick-tube, and having a screw for fastening it to the top of this globular-formed lamp. At the bottom of the ball there is a screw, flattened at its lower end to run in a groove in the candlestick, by which means, on turning the body of the lamp round with the hand, the screw enters the ball, and pressing the caoutchouc bottle, elevates the oil. Owing to the groove in the stick, the screw itself does not turn.

As these are lamps which are not intended to have glass-chimneys, it would be d[illegible]ans impossible, otherwise to reduce their shadows, than by doing away both with the fountain, and the necessity of increasing the size of the body of the lamp. I fear caoutchouc would too soon be affected by the oil, and be found likewise to have other objections to its use; at all events, fig. 3 may be more safely recommended. It is on a principle which I formerly suggested for filling lamps.* There would be no more shadow from a lamp on this construction than is observed on burning a mould-candle, which it very much resembles. The oil-cistern is placed in the stick, and there is another but lesser oil-reservoir for the wick, communicating with the preceding one by a tube placed central in the main pillar of the lamp. The upper end of the tube opens into the top of the lamp, and its other extremity screws into a small metal plug, which entering the cistern in the candlestick, serves as a syringe to raise the oil through the tube, on gently depressing the pillar. The pillar has two springs, which prevent its descending from its own weight.

Fig. 1.

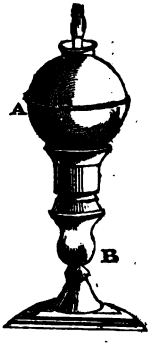

Fig. 1 represents the caoutchouc bottle-lamp in its perfect form. A, the metal globe, made of two hemispheres, containing the Indian-rubber bottle. It is held in the candlestick B, not by a tube, but by a screw having a flattened nut at one end, running in a groove formed in the stick.

* "Mechanics' Magazine," No. 284, Jan. 17, 1829.

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Fig. 2.

Fig. 2, a section of fig. 1. A, the metal ball; C, the bottle holding the oil and wick, and seen pressed upwards at the bottom by the screw D. B, here may be observed the broad end of the screw, together with the groove in which it slides. The rim E unscrews to admit of oil being poured into the lamp when it requires trimming.

Fig. 3.

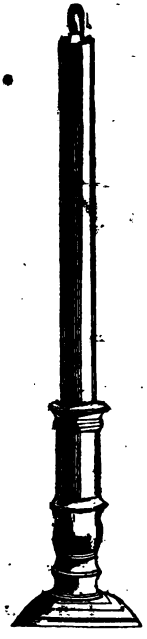
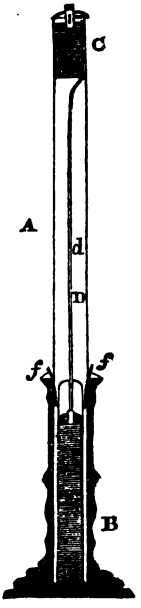


Fig. 3, a lamp, having the appearance of a mould-candle. The pillar or tube A slides over another tube inclosed in the stick B. The wick and oil occupy a space at C, two or three inches deep, and according as the appearance of the flame indicates a want of oil, the pillar A is to be slightly pressed downwards, when the oil will immediately ascend, on a principle which will be easily understood on reference to the following figure.

Fig. 4.



This is a section of the foregoing, in which A is the pillar, C the lamp, D a pipe of small bore, open at both ends, one of which terminates in the uppermost part of C, while the other is screwed into a perforated plug, made to fit exactly into a tube E, this tube serving as the main reservoir for the oil. When the large cylinder A is made to slide over the smaller one E, the oil, by the pressure of the plug, will be forced through the pipe D, thus refilling the lamp without much trouble. To counteract pressure caused by the weight of A, there are two springs, *f f*, which slide down with the pillar, keeping it firm in the stand. After lowering A to replenish the lamp with oil, the pillar may be raised

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to its proper height. When the plug is withdrawn by taking A out of the stick, oil may very readily be poured into the cistern E.

I remain, Sir,
Your obedient servant,
HENRY D——.

SOLUTION OF THE CASE SUBMITTED BY SENEX, VOL. XII. P. 252.

CASE.

The inhabitants of a certain street have agreed to have for their exclusive use a fire-pump; but the son of one of them, who is learning at the London University how to set people by the ears, tells his father that, as the houses on one side of the street are only three stories high, and those on the other five, the former ought not to be charged with the expense of the extra forcing-power, and extra length of hose, required for the latter. Will some reader of the "Mechanics' Magazine" be pleased to determine how the fact stands, and to say in what different proportions (if they are different) the inhabitants of the two sides of the street should contribute to the expense?

Sir,—In answer to the above case, I beg to offer the following observations. No data are given for a mathematical solution; it seems, however, to be of little consequence whether the water is to be conveyed to the top or centre of each building. The height to which the water will have to be lifted will in each case be in the proportion of 5 to 3, the number of stories in each house.

Now, if it be admitted that the expense is to be proportional to the *force* required by the engine in each case to convey the water to the above respective heights—it is evident, that the expense ought to be in the proportion of 5 to 3, whether the water is projected in a perpendicular, or in an inclined direction. If in the latter, the length of hose required in each case will be greater; and if the angle of elevation in both pipes be the same, their lengths will still be in the above proportion; and whether the water be forced up in a vertical or oblique direction, its pressure on the engine will remain the same. For although the pipes in an inclined position contain a greater quantity of water, a part of it presses on the pipes in proportion to its deviation from a vertical position, its perpendicular pressure being proportional to the sine, and its pressure on the pipe to the cosine of its angle of elevation above the horizon. When the pipes are in a vertical position, the weight of the water contained therein is all in a perpendicular direction, and a force must be exerted by the engine equal to its weight, merely to sustain it: whereas if the pipe is placed in an horizontal position, its weight is sustained by the pipe alone, and no force is required by the engine to support it.

The forcing-power will, therefore, be in the proportion of 5 to 3, and the *length* of the pipes the same, for equal angles of elevation. But if the angles of elevation of the pipes be different, their proportional lengths will also be different; consequently, the expense of pipe will be proportional to their lengths in each case.

If the water is projected in a *jet* through the open air, the force required will be proportional to the velocity acquired by bodies falling through a height equal to that of each building; "or, more correctly, the height of each building above the level of the engine."

N. B.—The pipes in the above observations are supposed to be perfectly smooth, and void of friction; and the *jet* in the latter case to experience no resistance from the atmosphere.

I am, Sir,
Yours, &c.
J. UTTING.

Lynn Regis, Jan. 1830.

REFUTATION OF THE REMARKS OF "A PRACTICAL ENGINEER" ON GILMAN'S STEAM-GENERATOR.

Mr. Editor,—On entering upon the task of vindicating myself from the malevolent imputations that some person, calling himself "A Practical Engineer," has thought fit so *liberally*, and no doubt *dis*interestedly, to bestow. I feel it necessary to premise with some remarks relative to his object.

When an individual wilfully *mis*construes sentences and perverts reason, for the sole purpose, (as it of course must be,) to throw odium upon another, he deserves, in my humble opinion, and as I have before remarked, very little

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attention—and, perhaps the most proper treatment he could receive, would be to pass over his verbage in silence; for the object cannot be mistaken, although he *may* shelter himself under the imposing title of a public censor.

The public evidently can have but one object, in inquiring into any matter propounded intentionally for its benefit, and that object is its value. Hence there can be no *motive* for prosecuting such inquiry, otherwise than by liberally interpreting any equivocal or ambiguous expression that might inadvertently have escaped the writer's notice, by fair and candid reasoning, and by just inferences. And hence, I presume to think, that when calumny and personalities are indulged in, such matter can no longer be considered as emanating from a *public censor*, but from some person who has assumed that character purely for the purpose of venting private spleen with impunity as regards personal identity.

Of calumny, it has been justly remarked, that it is almost impossible to extract the sting; and that calumny is the object of what this person terms his analysis, its internal evidences but too clearly evince.

> "The craven rook and pert jackdaw,
> (Though neither birds of moral kind),
> Yet serve if hang'd, or stuff'd with straw,
> To show us which way blows the wind."

This "Practical Engineer" disclaims any personal knowledge of me, and assumes that to be a sufficient reason, *why* his motives ought not to be impugned in making the attack in the manner he has. But I submit it does not follow as a necessary consequence, that *such* a censor should have a personal knowledge of an individual, in order to his entertaining malevolent feelings towards him, as there are a variety of causes which may operate to engender such feelings, although there should exist no personal knowledge, and even if there should exist, as in this case, no cause intentionally given.

The first part of my narrative is little more than a transcript from notes, simply describing the *facts* as they existed; and it will be seen by an *attentive* perusal, that it never was assumed or pretended, that the generator in question was perfect, and that its introduction with its acknowledged *im*perfections could be, as in fact it was, for no other purpose than merely to illustrate what had been done, and to prove the earliest *time* when.

Most of the objections urged, even if they were facts as they have been assumed to be, amount to very little as regards the real question at issue; which I take to be—not whether the apparatus described be the most proper, or this or that part of it the most fitting, to fulfil its destined purpose, but whether the *principles* of the *plans* put forth were conceived, and the apparatus *executed* at the time specified, for there exists no attempt or pretence to question the propriety of using a blast—of procuring a draft by means of exhaustion, or of causing flues to terminate in cisterns of water; consequently the whole affair resolves itself into a question of *time*, and becomes a matter of *individual* rather than of *public* interest.

Having made these preliminary remarks, Mr. Editor, I will now proceed to combat the things called facts; but in passing, my attention is first arrested by the apparent vexation which this person feels at the "dignified appellation," as he is pleased to term the title *you* bestowed upon the apparatus—to which, however, I was in no way privy; a more appropriate title possibly might have been found, but I presume it is not a matter of mighty moment.

To this succeeds the more serious charge, of my "extreme want of candour, and so much art in my paper." Would it not have been more *just*, first to have proved this? To convict first, and then condemn? But it seems from this and following paragraphs, that it is a principle with this "practical" person, in his tender mercy, to hang man first, and try him afterwards. I shall only state, however, in reply to such wanton assertions, that if a plain relation of facts exhibit art, if telling the truth be a want of candour, I plead guilty, most unequivocally, to the charge.

The first three lines of the next page, 324, col. 1, also contain a similar charge, wherein I am represented as being "most uncandid, and making an incorrect statement." And this charge, an old patent is brought forward to illustrate and support. Now, where no deception is practised, or even attempted, Mr. Editor, I presume, there can be no want of candour, and I am quite at a loss to discover by what process of reasoning the person comes to such a conclusion; for whatever may be the merit of the patent alluded to, or the circumstances that gave it existence, a reference to it could in no way influence or affect the truth of my state-

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ment. The three first lines of the first paragraph of my narrative, which are said to contain my want of candour and deception, by no means either deny or affirm the existence of such patent. There could, in fact, be no possible reason for referring to a matter neither making for nor against a set of experiments and practical applications, undertaken after a considerable interval had elapsed, under very different circumstances, with a different connexion, at a different place, and, though directed with a view to the same ultimate end, with totally different *means*. I cannot therefore, I take leave to repeat, possibly discover by what process of reasoning this "Practical Engineer," as he calls himself, has come to the conclusion, "that I am uncandid, and making an incorrect statement;" nor, probably, does he care, so that he can succeed in effecting his *worthy* purpose.

I feel some delicacy in obtruding private affairs upon public attention; but in this particular case, I must be permitted to observe, that the patent wherein my name appears conjointly with another person's, arose out of and was specified under very peculiar circumstances; and though what I am about to relate may, perhaps, vitiate the patent altogether, yet I can have no *hesitation* in doing so on that account, when I have long treated it as a mere nullity. No doubt parts of it are as *valuable* as the *law of expansions*, laid down by the "Practical Engineer's" friend, Mr. Woolf.

That the patent of 1825, contains some of my then views of a tubular generator, I have no hesitation in avowing; but at that time—a time indeed of great excitement in the mechanical world, on account of Mr. Perkins' alledged success—a very superficial knowledge of the capabilities of tubes existed, and, notwithstanding the immense sums of money that have been expended in experiments since, *few indeed* of the projects have realized the expectations that were entertained of them.

A very short time previous to that patent being taken out, a connexion was formed, perhaps inconsiderately, in consequence of an application from the person whose name the patent bears (then a perfect stranger as you are aware, Mr. Editor, for his application came through your hands); but the moment I discovered unequivocally the object and character of the party, and that I had been misled by false representations, I severed the connexion, and this happened long before the time for specifying arrived. No experiments were gone into, and I had nothing to do with the specification beyond what my agreement compelled: hence the ideas it contains are crude and undigested, and much matter introduced perfectly absurd, particularly that of the fourth and fifth claims, in which I most distinctly disavow having had any manner of participation.

I did not intend, Mr. Editor, to trespass further on the columns of your Magazine, in commenting on this part of the "Practical Engineer's" *analysis*, and will now only add, that one of *his* brethren, employing about 100 hands at least, did at that time (18 months ago) happen to make such a *furnace* or fire-place, as the one described in this patent, without knowing, of course, what I had proposed; and it appears, that no difficulty was experienced in passing *water* through the *immense length of tubing*, *without converting* it to *steam*. I mention this, not in commendation of the plan,—a plan which I could not now adopt, but to show the false position this *practical* person has assumed; for out of the two circumstances, on which the conversion of the water to steam depends, whilst traversing such tubing, he happens to have omitted the most important, if not the only one that governs the effect he contemplates, and that is the velocity, and consequently the *quantity* of water made to pass through in a given time: thus you see, Mr. Editor, this censor is not quite infallible, although he has presumed to ascend the judgment-seat.

We will now proceed to his "fearless assertion"—*fearless* only, I apprehend, on account of the protection, an assumed name affords him; he hazards nothing, and therefore hesitates not in asserting any thing. But to return to his *fearless assertion*—"that fuel under combustion was never subject to a pressure of so much as one pound, much less of three hundred to the square inch above the pressure of the atmosphere;" for this seems to be the gist of the sentence, which, however, taken as a whole, is not altogether very intelligible. This sentence affords another specimen of his purpose—misrepresentation: inasmuch as it affirms, that which was never asserted, namely, the *amount* of pressure; my narrative only states "*great pressures*," and that must be taken, of course, as comparative. But without further observation, I will describe the *means* employed to supply the fire with air, when every person can

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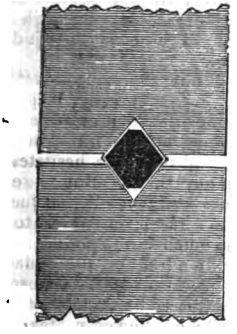
judge what degree of credit is due to this "fearless assertion."

There were two blowing cylinders, different in size, worked by a steam-engine, making about 30 strokes per minute. The contents of the large cylinder were compressed into the small one, the piston of which delivered it to the fire-chamber. Now, as neither the air so blown in, nor the products of combustion, had means of escape except through the tubes and valves into the water, under the pressure of the steam in the generator, I presume this "*fearless assertion*" has received a sufficient refutation.

The next thing that claims attention, is his "*shrewd remark*" of the total *impossibility* of the truth of what I have narrated; and this is "*shrewdly*" inferred, gentle reader, because of what? Why, because this *person* with *all his practical knowledge*, and with all his "*shrewdness*," cannot possibly conceive how *joints* can be made with such a narrow surface, even to bear low pressure steam, and hence he assumes it to be *impossible*. Now, as these joints and bolts seem to have sadly perplexed this *honourable champion*, I will indulge him with a detail of their construction, &c. First, then, the ends of the cylinders were accurately turned, and the cover and bottom nicely faced to joint with the cylinders. In each end of the cylinders, an angular groove was cut, as seen in the following sectional sketch.



Others of the same size and form were made in the bottom and cover of a diameter, answering exactly to the grooves, with which they were to joint respectively.

In making these joints, annealed copper wires of somewhat greater thickness than the widths of the grooves were prepared, by each having its ends brazed together, and formed into a ring of the diameter of the groove it was designed to occupy. These wires were laid in the grooves of each joint, as seen in the figure, when by means of the bolts, and the occasional blows of a heavy sledge, they were forced into the grooves, and became changed in form as represented, until they resisted further effort, and the iron surfaces were brought to within somewhat less than the sixteenth of an inch of being in contact. This description will prove sufficiently that such a joint is capable of withstanding an immense pressure, indeed much greater than I employed, and that, like every other joint, it will continue sound as long as the bolts prevent any separation.

The capability of the bolts to resist a separation will now be considered. With regard to their number, twelve, which has been so ridiculously objected to, I have to observe, that where the metal, forming a joint, is thin, a proportionately greater number are of course necessary; but in this case the metal is too thick to yield between the bolts, and the number, while it is more convenient, has proved in practice to be quite sufficient. This "*practical* person says, "*that these bolts* have to resist a *whole fifty tons*, which is impossible;" but here again, as in the former instance, where the water was supposed, erroneously enough, to be converted to steam, simply on account of the length of tubing, his practical *shrewdness* seems to have forsaken him; for the power of the bolts, to resist fifty tons, does not depend *exactly* upon their number, on the paucity of which he calculates, as *one* bolt would keep the joints, were all circumstances and other things fitting. But there is another *small matter* that has something to do with the question, and that is the *aggregate sectional area*. Now the aggregate sectional area of these twelve bolts is equal to 260 *tons*, before even any elongation could take place, according to the experiments of Captain Brown and others. Hence I presume to think that every unprejudiced person will admit their *capability* to resist the force of *fifty tons*, and secure the joints in question.

There is yet another point connected with these bolts that must not be passed over, and that is the effect of expansion. I need not tell your readers that wrought-iron expands more than cast; therefore it was calculated that in this arrangement the cast-iron cylinder being subject to a much higher temperature than the bolts, the difference of expansion would be exceeding small, if not entirely compensated, and the result proved the calculation to be correct.

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The only trouble that arose from the arrangement, which the drawings in your 330th Number represents, was the expansion of the internal cylinder, from its being in immediate contact with the fire before the steam got up, and consequently before the heat could produce a corresponding effect on the external cylinder: even this expansion, however, the *twelve* bolts had sufficient strength to control almost perfectly as regarded the external joints—resisting the expansion so completely, as to cause the wires of the internal joints to be forced into the grooves still further; but the necessary consequence of this was, that when the external cylinder did expand, the joints of the internal cylinder were rendered imperfect, and the apparatus useless, until they were restored. the difficulty, however, was soon obviated by altering the form of the joint at the top of the internal cylinder.

One of these expansions unfortunately happened when the much-respected Chairman of the Southwark Mechanics' Institution, Mr. James Horn, came to witness the operation of the generator.

(To be continued.)

BLOW-PIPE SIMPLIFIED.

A modification of the blow-pipe has been contrived by M. Danger, and is described in the "Bulletin d'Encouragement," which has simplicity and cheapness to recommend it. A wooden clamp, with a screw underneath to attach it to the edge of a table, has a hole bored vertically through it in front, and to this hole underneath is attached a tube, to the other end of which a bladder is tied. Another tube, which terminates with a jet piece, is attached to the hole above. It is obvious that if this bladder be inflated, and its sides pressed together by the knees of the operator, or by any other means, a stream of air will issue through the jet, and maintain the flame of the lamp To keep up the supply of air, a mouth-tube is inserted into a lateral opening in front of the clamp, and which reaches upwards to a convenient height for the mouth. By blowing into this tube occasionally, the supply of air in the bladder is preserved, and to prevent its return a valve is placed at the end of the mouth-tube. This valve is simply a piece of cork, fashioned to a conical opening in a tin or brass piece adjusted to the end of the tube A short wire, fastened to the cork, passes freely through a little guide, and is provided with a catch to keep it just within the conical opening. The mouth-tube may consist of two pieces, one sliding into the other, so as to be readily adjusted to any convenient length. The lamp should be covered, when in action, with a hood having two openings, one in front for the admission of the blow-pipe, and the other opposite for the exit of the jet of flame. The air may be forced out of the bladder mechanically, by surrounding it with a coarse net of twine, and hanging a weight to the bottom of it. This blow-pipe unites great simplicity to cheapness and facility of adjustment.

ECCENTRICITY OF SATURN'S RING.

Extract of a Letter from Prof. Schumacher to Prof. G. Maurice, one of the Editors of the Bib. Univ.

"The most interesting thing in astronomy, at this time, is the eccentricity of Saturn's Ring. M. Schwalz of Dessau, was the first to perceive it. He informed M. Harding of it, who thought he saw the same thing. M. Harding informed me of it, and both I and my adjuncts perceived what these gentlemen had observed, but I persisted in believing it to be an optical illusion, occasioned by the shadow of the planet upon the ring. I applied therefore to Mr. Struve to settle the question, by means of the superb micrometers attached to his great telescope. He had the complaisance to measure the distance between the ring and the body of the planet on five different days, and he ascertained that what we had seen was not only an appearance, but that Saturn's ring is really eccentric."—1828.

Inquiries.

Can any of your readers kindly inform me upon what principles, flutes and other similar wind-instruments are constructed? In harps and other stringed-instruments the different notes are produced independently of the others; but in flutes there is a connexion. I

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do not want to know those minutiæ which are necessary in making a flute, but merely the philosophical principles by which the different fingering produces the different notes. I am aware that a difference in the length of the vibrating columns of air produces a difference in the notes, but I want more precise and minute information.

WILTON X.

In what manner does the tongue divide the mouth into two cavities in the whistling of two simultaneous notes? A gentleman, whose name I forget, whistled several duets in this manner, in exemplification of a part of one of the lectures delivered by Mr. Farraday last year at the Royal Institution.

WILTON X.

How can a quantity of cork sufficient to float a man be applied to his body so as least to interfere with the free use of his arms in rowing in a heavy sea, and assisting in saving life in cases of shipwreck?

The life-preserver here in view must be cheap, simple in its fastenings, and not easily injured. It is presumed that painted cork, secured together by tarred or tanned whipcord, and fastening round the neck and under the arms by cork, with a loop and button, or piece of wood like a cat-frog, must be adopted, as giving to the body the least possible weight of materials with the greatest power of buoyancy, unless a canvas neck-collar filled with cork cuttings, be admissible as the top of the preserver.

LITTORALIS.

Sir,—Permit me to inquire what is the best and cheapest method of constructing a mill for expressing the oil from linseed?

Also, how long the meal will keep after the seed has been crushed without making it into oil-cakes?

A friend, for whom I make these inquiries, would wish to manufacture 20 tons in four months, by the *occasional* or *constant employment* either of horses, men, or oxen.

I am, Sir,
Your obedient servant,
J. S. S.

MINOR CORRESPONDENCE.

Effects of different Winds on the Colours of Vapours.—Sir, I feel it a trespass on your time and property to endeavour after *mere* publicity in the valuable columns of the "Mechanics' Magazine." Although the *statement* which appeared in page 320 of your 333rd Number, on the "*Effects of different Winds on the Colours of Vapours*," was certainly advanced with no other question than "*a wish to know* if any of your numerous readers had observed the various colours of the air according with the various points from which the winds come;" yet I thought it would be *as useful* to offer an explanation of the *cause*, as to give a simple answer to (granted) his only question. That explanation, I repeat, is *rightly given* in the *first seventeen lines* of my statement in No. 340, page 440; and howsoever such "*effects*" may astonish, no other *cause* than is *therein proven* can be found for them. But the Inquirer's public notice in page 5, No. 343, signed A. W., treats my *proffered explanations* as irrelevant to his question, and brings me into the predicament of an apologist to *him alone*; for, with *my* notions of utility, I addressed the explanations to your *readers in general*, because the instant an *inquiry* is made public it becomes a general inquiry, and demands the best explanation that science can advance. As for what follows my first seventeen lines of that explanation, I believe no other one of your readers will be led to pervert it from its integrity with the subject I have assumed, excepting (as *I have before stated to you*) that the word "*prism*" in the 5th line from the top of 2nd column, page 441,* should have been "*mirror*," and which mistake may have led A. W. to *talk about* "density of air" and "pure *crown glass*," so as to confuse your readers, and to confute an important fact—I mean the facts contained in *the whole* of my answer to his proposition as regards the *simple* effects of *light on all visible matter*. With regard, however, to "*atmospheric electricity*," I must humbly unite with A. W. in leaving the subject to more experienced heads. Still arguing for the "axiom," that *whatever is the cause* of light, its effects, *according to its power*, will invariably be to reflect one and the same gradations of tints according with the *positions* of the *power*, the *quality of the object*, and *the eye of the spectator*.

I remain,
Yours truly,
CHARLES HAYTER.

16, *Cirencester-place.*
March 8th, 1830.

Pedomotive-carriages.—Sir, in looking over the first volume of your useful and interesting miscellany, I observe that the drawing of Mr. Jameson's carriage is so far from "presenting to the mind of the readers the *whole design*," that it is perfectly unintelligible how the carriage can be made to move at all by any one sitting in it; for it seems to me to be impossible for a carriage of any description to be moved by a long stick, with a wheel at the end, without some more apparatus than appears in the drawing (see vol. i., page 409.) I also observe that Mr. J. has given very unsatisfactory answers (see vol. ii. page 82.) to the inquiries of K. W. (see vol. ii. page 141.) He has not stated how the long lever is to be managed, but has stated that *an acute angle* is to be the *fulcrum!* An angle to be a fulcrum! As such a carriage as Mr. J. wishes his to be, would be very useful to many persons in the country: a new and fully explanatory drawing of it would, no doubt, be acceptable to your country readers. The pedomotive-carriage of your ingenious Welsh correspondent, K. W. seems to require rather too much labour for it to become general, but might become very useful if contrived for one person only. As I am anxious to have such a carriage constructed for my own use, perhaps you would be kind enough to procure K. W.'s address for me.

Yours respectfully,
BENEVOLO.
January, 1830.

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* This error is noticed in the list of errata, published with the Supplement to vol. xli.

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[We do not know K. W.'s address, but should this meet his eye, he will probably favour us with it in order that we may communicate it to our correspondent.—ED.]

The Atmospheric Engine.—Sir, in article No. 18, page 654, vol. xix. of the "Encyclopædia Britannica," on the steam-engine, speaking of the atmospheric or single stroke engine (Newcomen's), it is asserted that the piston is not driven up by the force of the steam, but *dragged* upwards, "chiefly, if not wholly, by the preponderating weight of the pit piston rods." As I consider this statement decidedly erroneous, I shall be glad if any of your more experienced readers will favour us with such an explanation of the matter as may either confirm me in this belief, or show the correctness of the writer in question.

I am, Sir,
Yours, &c.
EXULPA.

Camera Lucida.—Sir, on reading the very able communication of your Exeter correspondent, signed "H. J.," in No. 336 of your valuable Magazine, on the "Camera Lucida," I immediately referred to "Adam's Geometrical and Graphical Essays," 4th edition, improved by Jones, and was much surprised at seeing no mention of it whatever in that work. There is a slight notice, however, of the Camera Lucida, invented by Dr. Hook, in the "Encyclopædia Britannica," and a more lengthened account in the last Supplement of the same work, with an explanatory plate of an instrument called by the same name, invented by Dr. Wollaston, which differs from Hook's both in its construction and in the purpose it is designed to serve.

Not being able to reconcile the two last accounts, and wishing for further information, I referred to the 311th number of your Magazine, in which, under the head of "Utility of the Camera Lucida," I found that Dr. Hook's was recommended.

What I wish to know of your scientific correspondent, is the true designation by which the instrument is known to mathematical instrument-makers, because I should prefer having the most useful and complete instrument of the kind; and from the authorities quoted, it seems there are two instruments of the name, one by Dr. Hook and one by Dr. Wollaston.

Any further information on this subject that your correspondents may be able to communicate, will be gratefully received by,

Sir, "A JUVENILE READER, of the 'Mechanics' Magazine, from the beginning."
Dorsetshire.

MISCELLANEOUS.

Gurney's Steam-Carriage.—"In the course of a few days the steam-carriage of Mr. Gurney will be carried into practical operation around London."—*Glasgow Chronicle.* This is rather a roundabout way for the people of London to receive London news. We speak advisedly when we say, that there is not the slightest probability of steam-travelling on public roads being realised for yet many a day. There are still great difficulties in the way of so desirable a consummation.

Stone-Mirror.—At Edinsor Inn, Peak, Derbyshire, there is a large slab of black marble, the produce of the vicinity, which has so fine a polish that it is by many mistaken for a looking-glass.

Greenland Lamps and Kettles.—According to Crantz, the potstone of which the natives of Greenland make their lamps and kettles, occurs but rarely in that region, though it is an article of trade among them. They carry utensils of it to districts where it is not found, and barter them for provisions, furs, &c. They are sometimes sent as presents to persons of distinction in Denmark, where they are highly valued, as it is thought that articles of food prepared in them are finer than when done in metallic vessels. The stone is soft and compact, and more easily carved or turned than wood. It does not crack or scale off, but hardens after being wrought, and grows firmer by fire. When rubbed with oil it acquires a beautiful porcelain smoothness.—*Geology of the Arctic Regions.—Silliman's Journal.*

Native Silver from the Mines of Pasco.—Professor Silliman, in the last Number of his Journal, describes a box of specimens from the mines of Pasco, which he had recently an opportunity of examining. Among numerous pieces of native silver there is "one pure and solid piece, without pores or intermixture, seven inches long, five and a half broad, and from three to two and a quarter thick; its weight exceeds 14 lbs. avoirdupois; and its value, as silver merely, is over 230 dollars." The Professor adds, "it appears to be a fine exhibition of the full dimensions of a rich vein or cavity of virgin silver, as it has the natural faces by which it was joined to the rock."

Stone-Butter.—On the banks of the Kamer de Maslo (Siberia), there is a fossil or earthy substance of a yellowish cream colour called by the Russians Kammenoze-maslo, or stone-butter, which is eaten in various ways, and is not disagreeable to the taste. It is probably similar to the mineral found in corresponding latitudes on the banks of the M'Kenzie, which Captain Franklin states is used by the natives for food in periods of famine. It oozes out of the rock in many parts of Siberia, and when exposed to the air hardens; but in wet weather it becomes soft, and even liquid. That found on the M'Kenzie resembled a kneaded paste, and was used by the traders, as stated by Captain Franklin, for whitening their apartments.

INTERIM NOTICES.

The notice, p. 304, vol. ii. was addressed to Benevolo. We shall be glad to be now favoured with the description referred to.

Communications received from Mr. Baddeley—E. L. D.—S. Y.—Mr. Utting—W. H. B.—R. J.—J. S. B.—R. C. Jun.—C. W. C.—J. G—y.—G. J. G.—Mr. Syngleman.

Errata.—In a few copies of last Number, p. 14, col. 1. l. 40. for "at p. 238, vol. iii." read "at p. 212, vol. viii."

P. 14. col. 1. l. 47. for

"$M \times \frac{p}{t} W$" read "$M \quad \frac{p}{t} W$."

Ibid. for "at p. 212, vol. viii." read "at p. 358, vol. iii."

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M. SALMON, Printer, Fleet-street.

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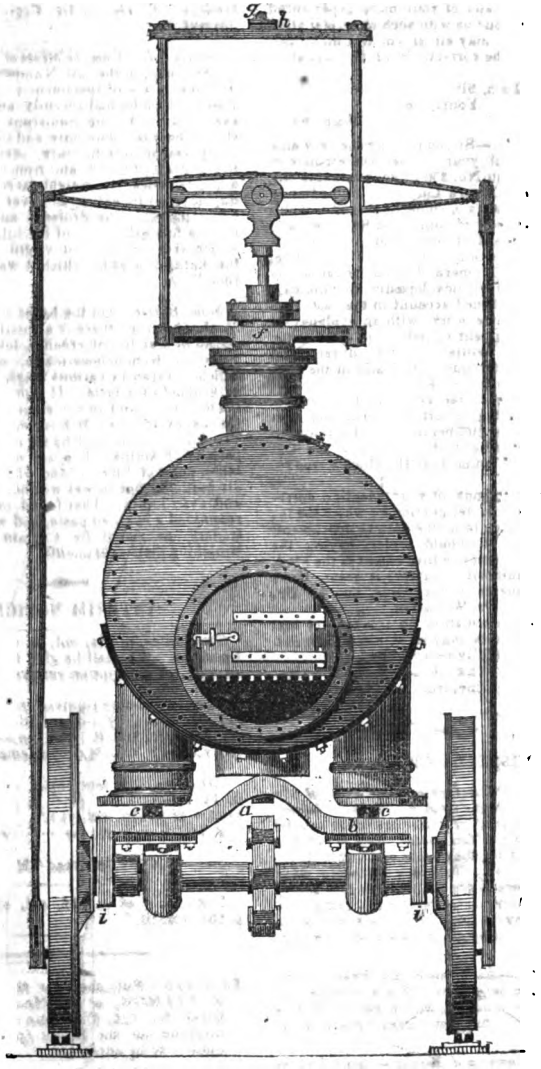
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 345.] SATURDAY, MARCH 20, 1830. [Price 3d.

THOROLD'S LOCOMOTIVE-CARRIAGE.



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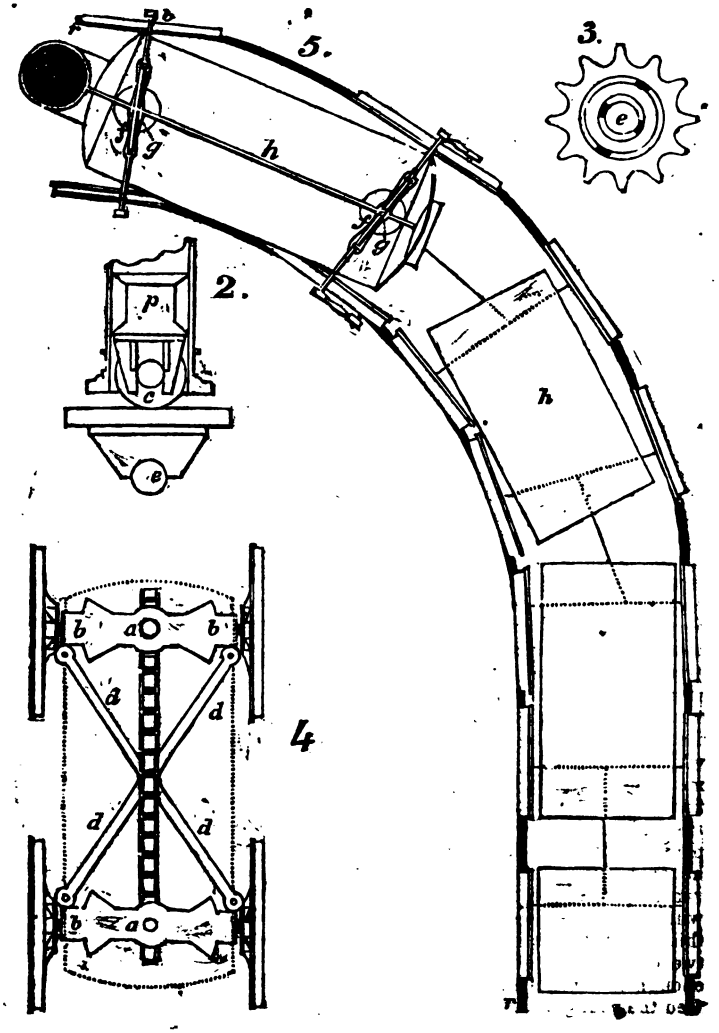
THOROLD'S LOCOMOTIVE-CARRIAGE.

Sir,—You will herewith receive the drawings of a plan for enabling Locomotive Engines to adapt themselves to a curved road, which suggested itself to me on reading Mr. N. Wood's treatise on rail-roads in 1825; by reference to which, it will be seen that it is purposely adapted to Mr. Stephenson's Engines.

Figs. 1, 2, 3, 4; *a a* show the centres upon which the carriages *b b b b* turn, the carriages have arcs upon which the rollers *e e* work; these rollers work in a carriage attached to the pistons *p p* of the bearing cylinders, which were then thought requisite to prevent concussion; *d d d d* are rods which connect the carriages diagonally, allowing them to move freely on their centres, but preserving their relative position; *e e* is the axis upon which the wheels are fastened.

Fig. 3 shows one of the chain wheels, connected by a universal joint to the axis *e*, this will allow the



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chain to work freely when the wheels are in a curve: this is important to preserve the action of the working pistons, so that one is in full power while the other is passing its centre. Fig. 5, gives a bird's-eye view of an engine under train of waggons, on a curved rail-road.

If, by inserting this in your Magazine, you will be serving the locomotive cause, I shall be gratified, not doubting your readers will make allowances for defects, when the time is taken into account at which this plan was conceived.

I am, Sir,
Yours, respectfully,
W. THOROLD, Engineer.
Norwich, Feb. 8, 1830.

FIRE-PROOF HOUSES—CAUSES OF, AND MEANS OF PREVENTING THE SPREAD OF FIRE.

Sir,—On proposing to construct a fire-proof dwelling, it naturally suggests the inquiry, what is it, in the present mode of building, that tends so greatly to facilitate the progress and spread of fire?

Every person who has given the subject a moment's consideration, will readily admit, that the staircase is the part which, above all others, assists the spreading of the flames; especially the staircases of modern buildings, which are composed of timber, cut up as if purposely intended for fire-wood. Well was it observed in your 343rd Number, that "we have only to look around us, and be satisfied, that in this great city abundant preparations are made in every direction for conflagration and sacrifice." If any person doubts the truth of this remark, let him inspect the unfinished skeletons of houses which abound in the suburbs of this metropolis. He will in most of them find the joists and partitions formed of one-and-a-half or two-inch deals, supported by similar materials; and, if he examines others in a more advanced stage towards completion, he will find these joists covered with thin deal floorings, the interstices between some of which "are wide enough to admit a slice of cheese to feed the young mice," and which afford the greatest possible assistance to the rapid spread of fire. The buildings to which I now allude are, in fact, just such structures as a person would run up who was about to try an experiment—the power of a new fire-engine, for instance—and wished to give the fire every possible advantage; and in one of these he would find a building in the greatest perfection for *his* purpose!

But I digress; the staircase is the means by which the flames extend from the bottom of the house to the top; embracing in their progress the landings, floors, joists, partitions, doors, &c., the heat from which speedily ignites every combustible substance in their vicinity, and so the whole building and its contents become enveloped in a glowing mantle of vivid flame.

When a fire breaks out in a house, and is discovered before it has gained possession of the staircase, its suppression is comparatively easy; but the stairs once on fire, the chance of saving the interior of the building becomes very slight indeed.

The skeleton or frame-work of a house having been constructed with brick-walls and partitions, and if circumstances permit, with brick-arches for supports, and all the joists, &c. of iron: to crown the whole, it then becomes necessary to add either a stone or metal-staircase; for, without an incombustible staircase, all the former provisions are comparatively useless.

To my mind, nothing gives a more elegant appearance to a house than a well-proportioned, clean, stone-staircase; and this material is, on many accounts, preferable to metal for the formation of stairs: nevertheless, iron stairs have their peculiar recommendations.

A building thus finished would remain unhurt, whatever might be the fate of its contents. Boarded-floors, carefully and compactly put together, might be laid down upon the iron-joists; and these might be guarded, by using a fire-proof composition for the ceilings. If any article of furniture were to take fire in one of the rooms of this house, the chance is more than ten to one that it would be consumed, and its power expended,

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before it would have ignited any part of the building. It would be a matter of great difficulty to ignite the floor beneath, from the tendency of flame and heat to ascend, and its aversion to the contrary direction; and it would be a matter of still greater difficulty to ignite that above, from the resistance to the flames which would be offered by the ceiling, the iron-joists, and finally by the closeness of the flooring. But to take an extreme case, suppose the quantity of furniture, &c. on fire were so great, as eventually to ignite both the floor above and below, still the fire would be so much retarded in its progress, that for several minutes a few buckets of water would be sufficient to extinguish it—or, sufficient time would be afforded to apply more powerful remedies. In such a building, the rooms which would be the seat of the fire, could always be subjected to the visit of a copious and well-directed stream of water. At present, while the engines are delivering ther jets in at the windows, the fire is rapidly spreading on every floor, and in every direction, by means of the staircase, which is very frequently so situated as to be sheltered from the reach of the water.

The sum total of the causes of the rapid spread of fire, is, in my opinion, the quantity and small scantling of the timber; the openness of the woodwork generally; the connexion existing between the several floors by the highly-combustible stairs; and the great draught afforded by the same.

The means of prevention are:—The shell and all the partitions of the house to be formed of brick-work; all the joists and supports to be of iron; the staircase of the same, or some other incombustible substance; and all open, hollow wood-work to be carefully excluded.

I would ask, what is there in a house constructed with a due regard to these modes of prevention that can burn? Why, the furniture and the fittings. Well, and suppose the whole of these were collected into one heap, what sort of a conflagration would they make? A very bonfire in miniature! The intense heat which is evolved at fires, is not produced by the furniture, but by the timber used in the construction of the house, and to which the furniture bears no assignable proportion.

By lessening, therefore, the quantity of this material, and placing that which is used in as unfavourable a situation for combustion as possible—the quantity of fire and heat, and its probable effects, will also be proportionably reduced.

This circumstance does not appear to be duly appreciated by J. S. S.; and this oversight will account for some of his extraordinary assertions. J. S. S. at p. 12, asks, will not the iron-joists of Mr. Farrow's fire-proof flooring* under certain circumstances become red-hot? Most decidedly they will not, whatever may be the intensity of the heat in the room below; consequently, they will not bend or ignite combustibles placed upon them, as J. S. S. insinuates. It may be as well to observe, that my remarks in this, as well as in my former paper, refer to dwelling-houses —*ware-rooms* are somewhat differently circumstanced, both as to form and contents.

To conclude—buildings in London may be divided into two principal classes; firstly, the small match-work edifices of which I have before spoken; and, secondly, larger and more strongly-built houses, with very massive timbers, &c.

In the event of a fire in houses of the first kind, they are all a-light from top to bottom in an instant, are wholly consumed, and the fire almost burnt out, before a single engine can be brought to bear upon them. Although the partitions between these houses are exceeding slight, yet the fire is so weak and of so short duration, that the adjoining houses are seldom injured.

In those of the second kind, however, fire spreads more slowly; and if discovered early, there is a better opportunity of applying the means of suppression with success. But if, on the other hand, the fire get any considerable head, it requires the utmost exertion to subdue it, and from the length of time which it rages, and the intensity of the heat, the adjoining

* See page 467, vol. xii.

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houses, notwithstanding their substantial party-walls, are frequently involved in the destruction.

The metropolis is at present composed of houses of these two kinds, and of every possible gradation between them; and it is from the combustible nature of our dwellings that those afflicting calamities arise, which human nature shudders at, and to prevent which human ingenuity has long been exercised, but exercised, alas! in vain. I say in vain, because no steps have yet been taken likely to prevent the continued repetition of these melancholy occurrences.

It is now high time that your readers should know something of the proceedings of the Society for Preventing Loss of Life by Fire, and these will form the subject of another communication.

I am, Sir,
Yours, respectfully,
W. BADDELEY, JUN.

March 8, 1830.

REFUTATION OF THE REMARKS OF "A PRACTICAL ENGINEER" ON GILMAN'S STEAM-GENERATOR.

(Concluded from p. 30.*)*

In other joints upon the same narrow principle—about $\frac{1}{2}$ of an inch—of which I have made a great number of different diameters—milled lead is employed instead of copper-wire. They are formed somewhat differently of course, but they are excellent and allow of being separated and perfectly restored (comparatively in a few minutes, if occasion required). Speaking of my allusion to these joints, the "Practical Engineer" ever ready to stretch or compress an expression, or sentence, to suit his *honourable* purpose, asserts in his second communication, that "I mean joints of two feet diameter." It is clear, however, that I neither did nor could mean this, but a hundred joints of such narrow widths as $\frac{1}{2}$ of an inch

The second part of the "*impossibility*" is the described mode of operating with the generator. The narrative not being designed to give a minute detail but merely a *general* outline, sufficient to define the principle of the plans; this part may perhaps be too loosely worded. The object however could not, unless intentionally, be well misconstrued; for although it is not said in so many words that "when the *whole* of the fuel," or a "*sufficiency* has acquired a state of intense ignition,"* —either of which expressions would have rendered the matter clear—yet a sufficiency of course only was meant, as the object in filling the chamber full was for store, in order that whilst operating with the cap described, the removal of such cap should be procrastinated as long as possible. If in alluding to almost any fire, we say that the fuel is in a state of intense ignition, it is not intended thereby to convey the idea that the *whole*—that every *bit* is in such a state. This however, though a common, is like many other modes of expression ambiguous; but if it be so, my using it neither proves any *want* of *candour*, nor that the generator had not been used, nor the *impossibility* of using it.

The seventh paragraph of my paper, which is next commented on, was inserted in my notes by way of memorandum, whence it was inadvertently copied into my narrative, and where it certainly had no business, as is evident by its want of connexion with the matter following and preceding it. Hence its insertion could not have been to serve any purpose, much less the purpose that this "*shrewd censor*" would wish to have your readers believe, it being impossible for *all* the *air* to pass into the generator by the upper branch; first, on account of the small size of the bore in comparison with the bore of the pipe leading to the bottom of the fire; and secondly, because a stop-cock regulated the admission of air by such branch.

Now for "*poor carbonic acid*:" You will perceive, Mr. Editor, that so determined is this *dis*interested and very *candid* person in the pursuit of his object, that he either does not give himself the trouble to understand the sentences which he criticises, or wilfully misinterprets them. Hence he observes, that I in my "*great simplicity*" take no notice of "the immense volumes of gases resulting from the combination during combustion of oxygen with the carbon of the fuel." The purpose of the paragraph in my narrative, Mr. Editor, to which this alludes, is to show that the elastic fluids, resulting from combustion, *are greater* in bulk and elasticity than the *air* necessary to the support of such combustion, and consequently that *greater* power is generated than the *re-*

* The "Practical Engineer" doubtless saw in this common expression "intense ignition," whole sentences copied from the patents *he* charges me with pirating.

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sistance which the atmospheric *air* opposes when forced into the fire, by which the friction, &c. of that operation is in a great measure compensated.

But though this be the purpose of the paragraph, as a child may comprehend, I did not consider it necessary to illustrate it more fully; the chief object of my narrative being, as before stated, to show the *principles* of the plans, and the *time* when those plans were projected, rather than to discuss their merit, particularly in detail. Hence the cause why I in my "great simplicity" did, for the *sake* of simplicity, omit the other products of combustion, notwithstanding that the "*immense volumes of gases*" resulting, are *entirely* in *my favour*.

It would appear however from this *practical* person's "*shrewd*" remarks, that I *purposely* neglected his "*poor carbonic acid*," because these "*immense volumes of gases*" would make against me; but it is manifest from what has been said that the converse is the fact, and that I could not be guided by any such motive in the omission; neither did I neglect his "*poor carbonic acid*" from ignorance of its existence, as the paragraph states, that the "*other* products were omitted" for the above-named purpose—*simplicity*.

After what has been said, I doubt if there exists any necessity to make another observation on the remainder of this *practical* person's *profound* analysis, *alias* his elaborate exhibition of inveterate malignity. But in order to prevent the possibility of any erroneous impression, I will just state briefly that no scoriæ or slagg ever accumulated in the intervals between its removal to cause the least inconvenience.

The next paragraph relative to the *cap* will have an answer in my concluding remarks, and with regard to my never having discovered but "that combustion proceeded as well, &c." I shall only add to what I have already said on this matter, that when the flue was uncovered, after an operation, the fuel was bright and reduced. This *practical* person however affects to believe that nothing can possibly exist excepting what *he* has experienced.

> "Strange tidings these; he tells the world he treats
> All but his *own* experience as deceits."

He professes to be "*more* for *practice* than *theory*." I have been always taught to believe, that practice and theory should go hand-in-hand—should be combined to form the most able mechanic, and that a practical man destitute of theory is a mere copyist. If the able strictures of this practical person and his friend Syngleman are *really* specimens of their mechanical abilities—are the offsprings of their practical experience; "God save the mark" and the public from such practitioners.

With respect to the patents, that this practical person charges me with pirating, I beg leave to observe, in addition to what I have already said to Mr. Syngleman in your 343rd Number, that there is at all events abundant evidence of *his* industry at the Patent Enrolment-office, as he appears to have left nothing untarned in search of matter to support him in his *laudable* endeavours to effect his *dis*interested object. With those patents he mentions however, and with which he seems so familiar (probably for a good reason), I am perfectly unacquainted, with the exception of Mr. Halls, of the year 1824, replied to in the above-named number. More than this, I may add that I did not know even of the existence of most of them—so little attention have I paid to what others have been doing. And I presume if I had, I should have found the same beautiful analogy existing between them and my plans, as the "*shrewdness*" of this practical person and J. Syngleman have discovered between the above-named Mr. Halls, and the principle I employ. These modern critics seem to possess the faculty of likening a thing to anything but to that which it really is like; and, no doubt, as *Polonius* in the play, they could imagine the generator to be a whale, if their purpose required it.

I observed in my answer to J. Syngleman, that Mr. Hall's plan neither suggested the *principle* nor *influenced* the arrangement of the generator in the smallest degree; and is there anything surprising in this, seeing the number of coincidences that are almost daily occurring? But suppose it *had*—suppose it had been an exact copy of Mr. Hall's apparatus, that would have been no reason for their dastardly imputations (which, by-the-bye, are equally applicable to the ingenious proprietors of "The Novelty,") Since, notwithstanding our having the same end and aim, namely, *the production of power*—the means of obtaining it are perfectly distinct. If such reasoning as that of these persons be admitted, it would be just as correct to conclude that, because the machinery of a corn-mill is composed of wheels and pinions, all machines composed of wheels and pinions must therefore be corn-mills; though I presume they

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would hardly get any person to agree in this, yet the analogy is quite as perfect. No person, however capable of understanding what he reads, could possibly make such an egregious blunder as these critics have done by confounding the two plans, much more any person of practical pretension. Hence it follows that these censors must have *wilfully* and *intentionally* done so to promote their own ends.

There is another charge of piracy which I had almost forgotten to notice—an important one too—and that is, that I have abstracted my last modification from the patent of a Mr. William Wilmot Hall. Before replying to this, allow me to say a word respecting what I have proposed in my narrative. Properly speaking, Mr. Editor, there are three plans, or one plan and *two* modifications, and it may be perceived by very little attention that they emanate from the same system, and that it would be almost impossible for the mind to conceive either of those plans, which are given as the *second* and *third* or *last* modification, without the other. Indeed both these plans were projected before any idea existed of applying the products of combustion more *directly*, as in the manner described by the drawings in the 330th Number; and perhaps they are still the more valuable, particularly the last modification. The date of Mr. W. W. Hall's patent, from which it is alledged my last modification is copied, appears to be, according to this "practical" person's statement, the 15th of January, 1827. Whatever analogy may exist between the two plans, I do not know—not having given myself the trouble to search for Mr. Hall's specification, nor even knowing its title; but this I do know, that a drawing of my last modification was presented to Charles Pearson, of Greenwich, Esquire, and Mr. R. Witty (whom I never saw but on that occasion), of Henly, Staffordshire, engineer, within a few weeks of Christmas, 1825—whether before or after I do not now precisely recollect.

To conclude—it never was intended to introduce into the "Mechanics' Magazine" more than was necessary to elucidate the plans proposed, and to *prove* their *existence* at the time specified; this being the sole object and purpose of the narrative. All the results relative to these plans at that time, as well as more recently, were designedly avoided. As to the "impracticability of operating with generator," this assertion of the "Practical Engineer's" is much about as correct as I have shown his other "fearless assertion" to be; for there existed no difficulty of the least importance, with the exception of the expansion of the internal cylinder or fire-chamber before noticed, that I now recollect. And as to the cap it was, as my narrative states it to be, a mere temporary expedient adopted in the first instance, and which is all that is necessary to be shown, in order to explain the principles. Of course no permanent flue would have been fixed without being *protected* by water. The cap and pipe being *temporary*, such protection was not necessary during the short period it was intended to use it. Mr. Hall's patented, and therefore permanently arranged apparatus in your 343rd Number, which the "Practical Engineer" eulogises as so superior, is doubtless *eminently perfect* in this particular; and perhaps this "practical" person will have the goodness to inform us by what magic the cocks *d d* and upper part of the furnaces A A are protected.

The generator shown in my narrative was arranged to embrace a variety of objects, and consequently it is unavoidably less complete for the purpose of any one in particular, than if it had been designed expressly for one object only. Other arrangements suggested themselves, but as any lateral connexion would have interfered with the means taken to strengthen the external cylinder they were abandoned. So "*absurd*," however, as the generator and the plans are, they will *bear* contrasting with Mr. Hall's, and many other of the most *striking* instances of *ingenuity*, even of our *reputable* "Practical Engineers."

After what has been said, I believe I may safely leave it to the judgment of the candid and impartial, as to whether there exists the *smallest* cause for the flippant condemnatory terms—the wanton and unjust imputations, and the puerile and silly ridicule in which this person calling himself a "Practical Engineer" has in the profundity of his wisdom thought fit to indulge. His *able* analysis, however, as well as the very *correct* and *candid* contrast of Mr. Syngleman, to which he was moved no doubt by the *good* "old English principle of every looker-on having a right to see fair play," proves one of two things; namely, that when men are actuated by no very honourable motives, it is easy to throw *truth* overboard, to *mis*represent and false-colour the most palpable facts, and dress them up in ridicule or otherwise, as best suits their

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purpose; or that it is far more easy to do this than for them to understand the subject on which they animadvert.

I shall now finish this paper, Mr. Editor, with the following quotation, which applies most aptly to this *concealed exposer* of *imposition*, or more properly *concealed vendor* of slander.

"Mark in dirty hole,
That busy animal, a mole;
Above ground never born to grow;
What mighty stir it keeps below!
To make a mole-hill all its strife!
It digs, pokes, undermines for life.
How proud a little dirt to spread,
Conscious of nothing o'er its head;
Till labouring on for want of eyes,
It blunders into light and dies."

I remain, Sir,
Yours truly,
WM. GILMAN.

London, March, 15, 1830.

Letter from Messrs. Jefferis and Co. to Mr. Gilman.

Mr. Gilman,

Sir,—In answer to your inquiries we beg to inform you that we furnished the castings for the generator, &c. shown by the drawings in the 330th Number of the "Mechanics' Magazine," published on the 5th of December, 1829, in the month of May, 1826, and which one of us saw repeatedly after its erection.

We are, Sir,
Yours, &c.
J. JEFFERIS & Co.

Greve Foundry, Southwark.

SOLUTIONS OF MR. GILBERT'S ALGEBRAICAL PROBLEM, VOL. XII. P. 252.

By H. T.

With due deference to the ingenious Proposer, it appears there is a redundancy of data in the given terms of the question; for, if S, the sum of the series, n the number of terms, and r the ratio, be given, all the other terms may be found. Thus by a well-known theorem in geometrical progression, $\frac{a(r^n-1)}{r-1}=S$, hence $a=\frac{S\times r-1}{r^n-1}$. Thus, if $S=100$, $r=2$, and $n=5$, $a=\frac{100}{31}=3\frac{7}{31}$, and the terms of the progression will be $3\frac{7}{31}$, $6\frac{14}{31}$, $12\frac{28}{31}$, $25\frac{25}{31}$, $51\frac{19}{31}=100$. Or, if the sum of the extremes be given, then $a+ar^{n-1}=S'$ $\therefore a=\frac{S'}{1+r^{n-1}}$. Suppose $S'=54\frac{26}{31}$, then $a=\frac{54\frac{26}{31}}{17}=3\frac{7}{31}$. Or, leaving out any one of the conditions proposed in the question, all the other terms may be found.

N. B.—Mr. Gilbert's lemma is not universally true; it only holds good when the ratio is 2.

H. T.

By the Proposer.

By subtraction, $y+z+w+l=S-s'$
Also $2y+\frac{1}{2}y+z+w+l=+r=s'$.
Hence by subtr. $y+\frac{1}{2}y=s'-\overline{S-s'}$.

$\therefore y=\frac{2\left\{s'-(S-s')\right\}}{3}=$

$\frac{2.(2s'-S)}{3}$. = second term. And since the multiplier is 2, all the terms are known, whatever be their number.

As an example. Let the sum of six terms in geometrical progression be 315, and the sum of the extremes 165. Required that progression, the multiplier being 2. Here $s'=165$, and $S=315$ $\therefore \frac{2.(2s'-S)}{3}=\frac{2.(330-315)}{3}=10=$, second term. Therefore the terms of the progression are 5, 10, 20, 40, 80, 160.

J. GILBERT, Jun.

[Mr. Gilbert's solution must be taken, subject to the same qualification as the lemma on which it depends; it is right only when the ratio is 2, which he supposes it to be. H. T., who has very properly pointed out this defect, has given a solution which is general, whatever the ratio may be.—ED. M. M.]

FARROW'S PATENT CAST-IRON JOISTS.

Sir,—As I suppose Mr. Farrow's statement, respecting the improbability of his wrought-iron joists getting red hot, to be only his *opinion*, and not a fact demonstrated by satisfactory experiments; I must still be

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permitted to retain my doubts, if iron (whether wrought or cast) for brestsummer joists or pillars, will without farther protection, be a sufficient security against fire.

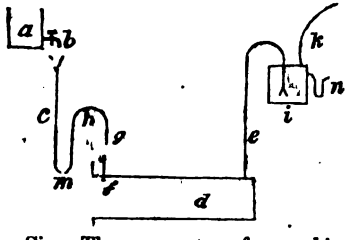
Before the fire in the Argyll-rooms, such an opinion as the one entertained by Mr. Farrow, might have been thought to be reasonable by others; but the facts there being contrary, and perhaps different to general expectation, should, I suppose, be a sufficient ground for an extended inquiry respecting the effect of heat on the strength of iron.

We all know when a fire in a grate is almost out, if a paper be put in amongst the dying cinders, the fire will soon draw up and the poker become red-hot; and in that state it may be twisted about in any direction, with, comparatively to its strength when cold, very little force: furnishing an easy practical demonstration, that neither much *fire* nor *time* is requisite for greatly reducing its strength.

If Mr. Farrow has tried the effect of a constant blaze upon *one part* of his iron joists for the space of two hours, and found that it could not in that *way* and *time* be brought to a red-heat—he would also probably find that a similar experiment upon one of the cast-iron pillars would be attended by a similar result. But would that prove that the pillars in the Argyll-rooms did not get red-hot, or that they were not bent by their load in consequence of their becoming heated?

I remain, Sir,
Yours, &c.
J. S. S.

FAMILY OIL-GAS APPARATUS.



Sir,—The apparatus for making gas from oil, described vol. i. page 401, even with the alteration recommended at p. 439, will not answer the purpose, as the gas would pass into the oil-vessel E, were the pipe A connected closely with it, and would prevent the proper supply of oil; and also, because the pipe A does not dip deep enough into the cistern D, to allow of the gasometer C to empty itself.

The apparatus, of which a sketch is prefixed, will be found effectual, and is as simple as the nature of the process will permit. That described at p. 401, "for *manufacturing* INVISIBLE AIR," which gas is, is also an inferior concern. The situation of the retort, at the back of the kitchen-range is very objectionable; the invisibility of the stream of oil passing through the cock on the pipe *b*, is another objection, and a great one; the small dip of the gas into the oil, would be found of little service; the having the cistern for the oil, a *close* vessel would be found inconvenient; and the partitions in the retort of little use.

Sometimes 100 feet of gas may be obtained from a gallon of oil, but I believe 80 is a more correct average.

I am, Sir,
Your humble servant,
BENEVOLO.

Description.

a, an open cistern for the oil.

b, a cock to regulate, visibly, the supply of oil.

c, a bent pipe with a funnel at top, inserted in the top of the retort, near the front end.*

d, a retort, which is to have a mouth-piece fitted to it at *f*, and to be nearly filled with coke or broken bricks. It is to be fixed over a furnace, and heated in the usual manner, and should be 3 feet long at least.

e, a pipe fixed in the top of the retort near the back end, leading to the condenser *i*. It is to have a funnel at the end for causing a larger quantity of gas to be exposed to the

* The length of the pipe *c*, from the level of the top of the bend at *h* to the bottom of the funnel, and from the bottom at *m* to the top at *h*, must be a few inches more than the dip of the pipe *e* into the oil, and the pressure of the gasometer: viz. if the latter is 1 inch and the former 8, it should be 12 inches at least. The bend of the pipe *m* need to be only a little more than the pressure of the gasometer.

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action of the condensing fluid (oil) than would be without the funnel, and should dip into the oil a few inches, say 6 or 8.

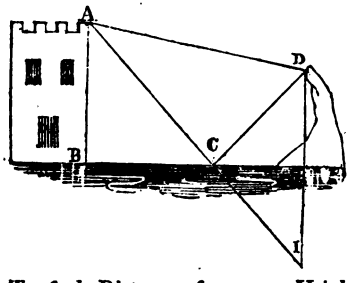
f, the open end of the retort, to which a mouth-piece (with door) is to be fixed.

g, a break in the pipe *c*, indicating that it is immaterial how far the bend *h* is situated from the retort.

i, the condensing vessel. A close vessel, into one side of which a bent pipe *n* is inserted. This must be fixed as many inches above the bottom of the funnel of the pipe *e*, as it is intended for the gas to pass through in the oil in the vessel *i*, and is for the purpose of keeping the surface of the said oil at the proper level.

k, a pipe fixed into the condensing vessel, anywhere above the surface of the oil for the purpose of conveying the gas to the gasometer.

A CATOPTRICAL PROBLEM, BY MR. W. SHIRES, MATHEMATICAL TUTOR.



To find Distances from one Height and one Station only.

Let a castle AB be close by the side of a river BH; and let DH be an object on the other side of the river, whose distance you would know; then from the nature of catoptrics, make the angle ACB equal to the angle DCH; then DC is the incident, and CA the reflected ray to the station A. Now, by observation, find the angles DAC and BAC, and having the height AB, we shall in the triangle ABC have the angle BAC, angle ABC of 90°, and side AB, to find AC; then from 180° take twice the angle ACB, (viz. twice the compliment of the observed angle BAC), and there will remain the angle ACD; whence in the triangle ACD we have AC, angle CAD, and angle ACD, to find the distance AD. The above problem may, perhaps, be pleasing to young beginners in plane trigonometry. W. S.

ON ADJUSTING COMPENSATING PENDULUMS.

Sir,—Passing by the whole of the small talk in Mr. Wynn's paper, No. 290, I come to his effusion respecting the adjustment of compensating pendulums, No. 295, page 117. This paper not only displays his total want of knowledge in the matter he is handling, but it seems to elicit *some other negative qualities besides ignorance*, which by no means redound to his credit. When we reflect that there is nothing more natural to man than an aptness to suspect in others whatsoever we feel in ourselves a disposition to do, what must we infer from his saying, "that for a workman *to pretend* to apply a compensating pendulum to a church-clock, unless he has to live on the spot for many years after it is made, and unless also he has had instruments for observing the sun, of the most expensive kind, attached to the same building as the clock, *he would only be imposing on the parties giving the orders*," &c.? Mr. W. having before given us the outlines of his picture, he now supplies us wherewith to give colour to the portrait. He also gives us the height and depth of his astronomical attainments; because it is not necessary to observe the sun at all in ascertaining the rate of a clock—a star being far more eligible for the purpose, not only from rendering the observations more instantaneous, and consequently the more exact; but because the time of a fixed star transiting either the meridian or any other fixed point, cannot be affected by any variation in the progressive motion of the earth, as I have shown, No. 255, page 370. Neither is it necessary to fix any instrument to the same building as the clock: the only thing that is required for determining *the rate of a clock*, is a piece of plate-copper or brass with a small hole in it for a sight; and this being fixed

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in a suitable place in the neighbourhood for observing the approach of any star that may be chosen for the purpose, towards any building at 20, 50, 100, or 200, &c. yards distance—the instant of its disappearance behind such building, as observed through this sight, being noted—the same star will arrive and again disappear behind the building in precisely 23h. 56m. 4·1s.; of course a good pocket-watch being set exactly to the clock a little before each approach of the star to the building, the interval of time between the two disappearances may be taken probably to half a second. It is unnecessary to add that the observations may be continued 2, 3, 4, &c. evenings, as may be thought desirable either for precision or satisfaction, or as the weather may permit. But as such exactness must be altogether useless, *unless the clock itself be so constructed as to keep an uniform rate*, it will be proper to show Mr. W. the possibility of a very near approximation to such an attainment, and also that it may be accomplished without such superlative difficulty as he represents.

As to "observing the sun," I choose to apprize him that the time cannot be exactly known by the sun, certainly not to less than a second—to say nothing of the irregularities to which solar time is subject from the *libration* (if I may so express it) of the earth occasioned by the moon:* and from the attractions of the planets, and especially of ♃ and ♀; all of which disturb the motion of the earth in its orbit, and consequently require equations to correct the time shown; but which is avoided by taking a star instead of the sun, at the same time that the equation-table is also dispensed with.

But to set the clock precisely to time after its rate is adjusted, requires superior means. The most correct method undoubtedly is that of a star transiting the meridian, as observed through a transit instrument; a table of the acceleration of the fixed stars for the year being provided, in which the errors arising from the aberration of light, and from the nutation of the earth on its axis are corrected.

Now as the first great means of producing a steady rate in a clock is by a compensating pendulum, I shall proceed to show that such a pendulum may be made with both ease and certainty, notwithstanding Mr. W.'s luminous statement to the contrary. The proportions of the expansion and contraction of metals and other materials at different temperatures, are ascertained by the pyrometer to a degree of truth, including several figures of decimals: of course these proportions being so exactly known, it necessarily follows that Mr. W. must needs be possessed of great self-complacency to have the hardihood to assert that, which is tantamount to denying the possibility of the proportional lengths being measured! It cannot be a question, but it may be done to a degree of precision, by which $\frac{9}{10}\frac{9}{0}$ of the usual variation of a wooden-rod may be done away. But admitting that only $\frac{1}{10}$ of such variation be done away, it will remain for him *who does not hesitate to say that it would be worse than a common one*, to explain the reason why it would be worse? It is true there are small differences in the variation of different pieces of the same sort of metal, by which the compensation might be affected, were it not, that *there is no difficulty in determining the real variation occasioned by different temperatures in the identical materials to be used*; whence the proportions may be measured to the greatest nicety. I shall however suppose the compensation to extend only to $\frac{1}{10}$ of the variation to which a wooden-rod is subject; so that there will be $\frac{1}{10}$ part still remaining. And as the variation in time is as the square roots of the

* As the earth and moon revolve round the common centre of gravity of their masses, it follows that neither of them keeps the regular path or orbit round the sun, and that it is this common centre which always proceeds along the orbit; consequently when the moon is at the quarters, the earth is more than 3400 miles out of its true place—being that distance too forward at the first quarter, and as much too backward at the last quarter, as appears by a solution of this problem (which the common centre of gravity falling within the body of the earth, rendered necessary for determining this point), with which I have been favoured by Mr. J. D. Sollitt, of Hull, and which I may probably send *for* insertion in a future Number.

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variation in length, it follows that the errors of the compensating pendulum will be 400 times less than those of the other.

The difference between extreme hot and cold weather in this climate is about 70°; namely, from 20° to 90° of Fahrenheit. But as these great extremes are not frequent, and when they happen, seldom continue; it follows that a variation of 30° from temperate, viz. from 25° to 85° will be esteemed more correct data. Now the difference in the length of a steel-rod pendulum between temperate weather and 30° either above or below temperature, is such as to cause about 8 seconds per day variation; and the difference in the length of a wooden-rod, occasioned by difference of temperature, is about three times less than that of steel, so that the effect will be about nine times less—that is, a wooden-rod will not vary quite one second per day between temperate weather and either extreme. Then the variation in length being reduced by compensation to only $\frac{1}{10}$ part, thereby causing only $\frac{1}{100}$ part of the variation in time, it follows that the actual variation would be less than one single second, although the weather should continue in either extreme a whole year together. Therefore, as the extremes of heat and cold during the year may be considered to compensate each other, and the generality of the weather being temperate, it will follow that a well-compensated pendulum will not in itself be inclined to vary in its rate a single second in several years.

But lest Mr. W. should still doubt the possibility of making such a pendulum by admeasurement, because of the difficulty of determining the complicated effect of the weight and distance from the centre of suspension of the compensating materials, it is proper to inform him that I have invented a compensating pendulum of a peculiar construction, of such materials as seem to be *the most regularly affected by heat and cold and not at all affected by humidity*, and which will evidently admit of this important matter being accurately ascertained, so that the proportions are really subject to admeasurement. And the advantage of adjusting the compensation by measure, over that of adjusting it by the rate is prodigious, seeing that *an error of one hundredth part in measure gives only an error of one thousandth part in time*, and is done with infinitely less trouble. Indeed the impossibility of perfectly adjusting the compensation of a pendulum by the rate is obvious, because the time of oscillation may be affected by a difference in the density of the atmosphere (which is subject to continual changes), and also by any irregularity in the impulse of the pallet-wheel, occasioned either by imperfections in the train, or by friction, &c. which, in such clocks as have hitherto been produced, must have considerable effect; whereas the pendulum being constructed in such manner as to be depended on, the other causes from which deviations in the rate of a clock may originate, may the more readily be traced to their true source; although to provide a remedy for them will certainly require very superior judgment to that evinced in the specimens Mr. W. has given us.

JAMES HARRISON.

Barton-upon-Humber,
October 3rd, 1829.

VELOCITY ON RAILWAYS—REPLY OF S. Y. TO R. C., JUN.

Sir,—I am quite aware that the quantity of mechanic force, which is sufficient to maintain a definite velocity in a machine, is sufficient to procure that velocity; and that it is a compound question not only of inertia and friction, but also in this case of the resistance of the air; but as I told R. C. before, it was the *friction only*, that there was any dispute about.

As to the absurdity of *The Scotsman's* assertion, being "abundantly proved by showing the limiting velocity which a certain expenditure of power will maintain, in an unresisting medium"—I answer, that there is *no power whatever* necessary to *maintain* the velocity in the case R. C. supposes; as he himself acknowledges, when he says the tension of

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the string ultimately becomes = 0. *If there were* a maintaining power necessary, his method of proof would be applicable.

R. C. says, page 421, vol. xii., "The result of all this is that if a body be drawn by another in an unresisting medium, let the latter be ever so small, the former will ultimately attain the velocity of that by which it is moved, and no more." Now, in "sober seriousness," did R. C., jun., imagine it necessary to occupy six columns of your work to convince your readers, that if the resistances of air and friction were entirely removed, even then, a carriage on a railway would not move faster than the horse which drew it? This gentleman reminds me of Hudibras, who could

> ——"wisely tell what hour o' th' day,
> The clock did strike, by algebra;"

and I cannot yet perceive how R. C.'s papers bear on the question. In fact, he admits, that his observations have nothing to do with "the quantity of mechanic force, equal to the resistance caused by friction," which is *all I said of them*—for it is this, and *this only*, concerning which there was any misunderstanding, or difference of opinion. But I trust, nothing I have said will prevent our hearing again from R. C., on this or some other subject. I will just observe to him, that it is one thing to understand the sciences, and another to know how to apply them properly. As to the communication at page 238, vol. iii., being sufficient to lead him to the opinion he had formed, it very likely might be, and I take it for granted (for I cannot refer to it) that it was so. Neither can I refer to page 212, vol. viii., and all I will say is, that if there is no difference in the result of S. Y.'s statement and *The Scotsman's*, I must have very much misunderstood the meaning of the latter.

Yours, respectfully,
S. Y., an Engineer.

March, 10, 1830.

ANCIENT LIGHTS—NEW BUILDING ACT.

Sir,—It is not one of the least of the evils of the present day, that there is nothing definite respecting what is usually called "*an ancient light.*" Indeed, the opinions which have frequently been given, appear to me very far from being just.

If A and B have adjoining grounds, either the one or the other, I presume, may enclose his own ground by a fence of any height and of any materials, either transparent or otherwise. Previously to any fence being erected, there was nothing to prevent A looking into the grounds of B; and *vice versa*. Now, neither the one nor the other need deprive himself of any view unless he chooses; and either may, if he thinks proper, make such erections as will prevent his neighbour looking into his premises.

If A makes a fence, either in the whole or in part of transparent materials, no length of time ought to give him a right to prevent B from making an opaque fence against the whole or any part of it. Such a right should only be obtained by purchase or gift; and, unless A can show by deed or register that such right has been granted to him, and also, that B has agreed not to build within a given distance, he ought not to have the power of preventing any erection that B at any time may require.

But, as the necessity for a deed or register of the grant and extent of such a privilege has not hitherto been enforced, let it now be made the law in the "New Building Act," that all lights which have existed without interference for 31 years, be considered "*ancient lights*," and that, from and after the 1st of January, 1800, no such right shall be acquired by *time*.

This would make the A's, or first builders, more careful, and leave them without a hope of acquiring, except by courtesy or a fair equivalent, such a privilege; and I doubt not, but it would also prevent much litigation and ill-will between neighbours, of which many can say, there has already been a great deal too much, and that solely occasioned by the want of such a definite law as is now recommended.

Yours, &c.
C. D. S.

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QUADRATURE OF THE CIRCLE.

Sir,—Among the various series for the quadrature of the circle, your correspondent T. F. M. (p. 15) has, unfortunately, fallen upon one which converges most slowly. But even this, as I am sure he will be glad to learn, may be summed, approximatively, with far less labour than he has devoted to it.

The method is this. Place the decimal values of the first twelve or fourteen terms of the series, under each other in a vertical column. Take the sum (attending to the distinction of positive and negative) of two of these terms, then of three, then of four, &c., (which are so many alternate additions and subtractions of a line), and place the successive amounts, as they occur, in a vertical column to the right of the former, these being placed individually *between* the former terms. Taking the *last* 6 or 7 terms of these successive sums, find the *arithmetical means* of each two, as they occur vertically, and place them *between* each pair of terms, in another column to the right hand. In like manner, place the successive arithmetical means of these means, in another column to the right. Proceed in the same way with the means of these means, and so on. In this case, I have proceeded to the *fifth* mean, which gives the result true to the *sixth* place of decimals.

Terms.	Successive sums.				
$+1=+1\cdot00000000$					
	$\cdot66666667$				
$-\frac{1}{3}=-\cdot33333333$					
	$\cdot86666667$				
$+\frac{1}{5}=+\cdot20000000$					
	$\cdot72380953$				
$-\frac{1}{7}=-\cdot14285714$					
	$\cdot83492064$				
$+\frac{1}{9}=+\cdot11111111$					
	$\cdot74401155$				
$-\frac{1}{11}=-\cdot09090909$					
	$\cdot82093463$				
$+\frac{1}{13}=+\cdot07692308$					
	$\cdot75426796$				
$-\frac{1}{15}=-\cdot06666667$					
	$\cdot81309149$				
$+\frac{1}{17}=+\cdot05882353$		$\cdot78677570$			
	$\cdot76045991$		$\cdot78552256$		
$-\frac{1}{19}=-\cdot05263158$		$\cdot78426943$		$\cdot78541359$	
	$\cdot80807895$		$\cdot78530462$		$\cdot78540051$
$+\frac{1}{21}=+\cdot04761904$		$\cdot78633992$		$\cdot78538743$	
	$\cdot76460069$		$\cdot78547025$		$\cdot78539663$
$-\frac{1}{23}=-\cdot04347826$		$\cdot78460068$		$\cdot78540583$	
	$\cdot80460069$		$\cdot78534142$		
$+\frac{1}{25}=+\cdot04000000$		$\cdot78606217$			
	$\cdot76756365$				
$-\frac{1}{27}=-\cdot03703704$					

Successive arithmetical means.

Here I think the whole operation has not taken me more than half an hour; as I extracted the quotients in the first column from Mr. Goodwyn's valuable table of "Pure Decimal Quotients;" and the remaining work is, obviously, very simple. Indeed, without the aid of this useful table, all the decimal values except those of $\frac{1}{17}$, $\frac{1}{19}$, $\frac{1}{23}$, $\frac{1}{25}$, are found, by *short* division, with the utmost possible simplicity.

Your correspondent will be much interested with the results, if he applies this method to the approximate summation of other slowly-converging series, such as

$1-\frac{1}{2}+\frac{1}{3}-\frac{1}{4}+\frac{1}{5}-\frac{1}{6}$, &c.
$\frac{2}{1}-\frac{3}{2}+\frac{4}{3}-\frac{5}{4}+\frac{6}{5}-\frac{7}{6}$, &c.
$\frac{1}{1}-\frac{2}{3}+\frac{3}{5}-\frac{4}{7}+\frac{5}{9}-\frac{6}{11}$, &c.

And, in performing the operations, he will be struck, as also in examining the above, with the fact that the numbers, not only in the column of successive sums, but in each column of means, are alternately too great and too little, yet so as visibly and continually to approach to each other, and to the sum of the series.

Having no desire to shine in borrowed plumes, I must not omit to say, that this method of summing slowly converging series was invented by the late Dr. Hutton, and published fifty years ago. It is not, however, half so well known as it ought to be, so that you may perhaps admit it into your ever-instructive Magazine.

This method is again inserted in the first vol. of Dr. Hutton's Mathematical Tracts, to which I observe you sometimes refer.

Your correspondent T. F. M. is not likely, from the circumstances to

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which he alludes, to have this work in his possession, or at his command. But, I perceive from his signature, &c. that he lives at Woolwich. If I have not made a great mistake as to private character, to love of science, and desire to promote it, in the gentlemen to whom I am about to allude, I may add, without any risk of giving offence, that there are three individuals connected with the Royal Military Academy at Woolwich, viz. Dr. Gregory, Mr. Christie, and Mr. Barlow, either of whom would, I presume, lend him the volume to which I have above referred.

E. L. D.

Ravensbourne Works,
March 9, 1830.

EXPRESSING OIL FROM LINSEED—ANSWER TO THE INQUIRY OF J. S. S.

The best and cheapest mode of expressing oil from linseed, is by the old-fashioned stamper and wedge-press. I have known the hydraulic and steam-presses tried in various instances, but they do not answer so well as the old plan. I never knew an attempt made to keep the "meal," but I conceive it would not keep long; the seed when whole, requires frequent turning. The rest of the inquiry of J. S. S. can be answered by any respectable mill-wright who may undertake the building of the mill.

S. Y., an Engineer.

Newcomen's Engine.

Exulpa (p. 32) will find the "Encyclopædia Britannica" correct in its description of Newcomen's engine; and he will readily perceive it is so, when he is reminded that the pressure of the steam used in these engines, per inch, never much exceeds, and is commonly about equal to, the pressure of the atmosphere; therefore, when the steam is under the piston, and the atmosphere over it, they do but balance each other; and there is no moving power but the counter weight, or "pit piston rods."

S. Y.

CAST-IRON GUTTERS.

Sir,—A frequent cause of fire is the necessity of repairing lead-gutters, which requires the use of braziers on the roof. It was in this way Old Drury Lane Theatre is supposed to have caught fire. While others are recommending iron-joists and doors, let me therefore repeat a suggestion of Bonomi, the architect, and recommend gutters of cast-iron.

I am, &c.

VULCAN.

LEE'S HEMP AND FLAX MACHINERY.

Sir,—I have often wondered what has become of Lee's patent method of preparing hemp and flax without previous water-rotting, about which we heard so much some fifteen or sixteen years ago. There was an Act of Parliament, if I mistake not, passed, extending the patent for a term of years; I remember, at least, reading a Parliamentary Report in which the invention was spoken of most favourably. Any information which you or your correspondents can favour me with on the subject, will oblige

Your obedient servant,

A WILTSHIRE FARMER.

[An Act of Parliament was granted to Mr. Lee (in 1813), but not for the purpose of extending the term of his patent; it merely authorized the concealment of his specification for a certain period, in order that the invention might not be carried abroad. The process, though tried on a large scale, was attended with but indifferent success; and Mr. Lee's manufactory having been consumed by fire, it has been since wholly abandoned. —ED. M. M.]

Postscript to S. Y.'s Reply to Mr. Harrison, (received too late for insertion last week.)—"I may observe, that the diagram (see p. 23) is only intended to explain the principle, which will remain the same, whatever proportion the size and length of the teeth may bear to the diameter of the wheel. Nor is it by any means necessary that the lines forming the two sides of the teeth should be continued until they intersect."

S. Y.

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MISCELLANEOUS.

Lamp-Glasses.—A very simple but effective precaution is said to be employed in Paris to prevent the breaking of lamp-glasses by the application of sudden heat. Before they are used, a glazier scratches or cuts the base of the glass with a diamond, and afterwards sudden heat may be applied without damage.

Sheet Caoutchouc.—Dr. Mitchell, of Philadelphia, gives the following process for preparing sheet caoutchouc:—"Steep a bag of caoutchouc in sulphuric ether until quite soft, say from four to twelve hours, or any longer term. Take it out, and quickly attach to its neck, by a flat string, a stop-cock, and inflate with the mouth (this process succeeds best in a cold room). When well prepared, the balloon will rise with hydrogen, by means of which it should for such a purpose be inflated. Cake-caoutchouc soaked in ether until soft, is easily cut with a wet knife, or under water, and may thus be made as thin as required. By soaking in ether for some days, massive caoutchouc may be moulded by hand into any shape whatever, and is nearly as manageable as dough." Dr. Mitchell has also discovered that essential oil of sassafras will dissolve caoutchouc readily after being softened in ether; and that after evaporation of the solvent, the caoutchouc remains unaltered.—*American Journal of Science and Arts.*

Prevention of Back-water.—A new work, published by Dr. Bigelow, of America, entitled "Elements of Technology," contains the following remarks on the subject of overshot and breast-wheels:—"The pressure of the atmosphere occasions sometimes a serious obstruction to the motion of overshot-wheels, by causing a quantity of back-water to be lifted or sucked up, by the ascending inverted bucket when it first leaves the water. The difficulty is remedied by making a few small holes near the base of the bucket, and communicating with the next bucket. Through these the air will enter, and prevent the suction. It is true that when on the descending side these holes will allow the escape of some water; but as this water only flows from one bucket to the next, its effect is inconsiderable when compared with the advantage gained. Air, as Professor Robison observes, will escape through the holes about thirty times faster than water under the same pressure."

Night-Angels is the fantastic name given by an American patentee of the name of Cook to certain new dishes and caps for preventing bugs from ascending the posts of bedsteads. The best defence, as Dr. Jones, of the *Franklin Journal*, well observes, against these nocturnal tormentors, is cleanliness; and those who lack the industry necessary for their destruction, will call in vain either on Hercules, or Mr. Cook's Night-Angels, to protect them from the fangs of these disturbers of their repose. "The effect to be produced by these Night-Angels," Dr. Jones adds, "we have repeatedly attained by a magic circle around the lower end of each bedpost. This circle was merely a line made with chalk, over which the legion cannot pass; the loose particles upon which they tread giving way beneath their feet, and precipitating them to the lower regions."

Volatility of Alcohol.—It appears from some experiments related in Ferussac's Bulletin, that the volatility of alcohol is not, as might be supposed, in proportion to its specific levity. In an [illegible] state it is less volatile than when it [illegible] portion of water, and when the degree of [illegible]nt of density is passed, the weakest [illegible] first and the strongest last.

Indian Corn.—Among the uses to which Indian corn is applicable, and which Mr. Cobbett, in his treatise, has omitted to mention, are the making of beer and spirits. It is known that large quantities of the latter article are made from it in Adam's County Ohio, Cincinnati, Nelson County, Kentucky, Cayuga County, New York, and doubtless in many other parts of the United States. Indian corn and rye are generally mixed about half and half. The produce from the Indian corn by itself is represented to be about two gallons from each bushel of corn; a description of the mode of malting, or the process of distillation, is wanting.—*Gard. Mag.*

Cutting Glass with a hot-iron.—Mr. Farraday has devoted four pages of his recent work on Chemical Manipulation to an account of the methods of cutting glass with a hot-iron, but he has omitted one precaution which I have found important in cutting large tubes, vials, &c., that of not making the iron too hot. It should be heated to a redness barely visible in day-light. If in this state it be caused to vibrate a few times round the tube along the track where the division is to be made, and a drop of water put upon the spot, a simple fracture, without side flaws, will be obtained. By pursuing this method, especially if a trace be made before hand with a file, a long tube may be cut up into sound, well-defined and narrow rings, without a single instance of failure. —*Correspondent of Professor Silliman's Journal.*

Railway Projects.—The American papers announce that Colonel De Witt Clinton, the son of the late Governor of New York, has projected a railway between the Hudson and Mississippi, which will be one thousand miles in extent. Magnificent as this project is, it is nothing to one of our esteemed friend, the Editor of the *Gardener's Magazine*, who, speaking of the new prospects which railways and steam-carriages have opened to the world, observes, "We have *no doubt* that the time willl come when a railway will be laid down between *Paris* and *Pekin*, and steam-carriages be employed on it. The tract of country by Berlin, Vienna, Moscow, and Astrachan, we understand is almost level, and if the governments of Europe were to become shareholders in such a railway, there can be little doubt it would pay."

INTERIM NOTICES.

Mr. Syngleman's letter next week.

S. Y. intimates that he intends sending us a criticism on the paper, p. 323, vol. xi. and an answer to that p. 3, vol. xiii. He observes in the meanwhile, "I perceive Mr. Harrison has mistaken my friendly admonitions for an attempted criticism on his paper, and makes some, what I consider, unjust remarks, p. 3, vol. xiii. This gentleman has a method peculiar to himself. For example—I say that *involute* teeth work almost without friction; in answer to which, he very gravely sets himself to work to prove that *epicycloidal* teeth do not!"

A Practical Engineer is requested to favour us with an address to which we may forward a letter to him.

Communications received from G. S.—Mr. Hayer—S. Y.—Indigens—R. H.—Delta—I. A.

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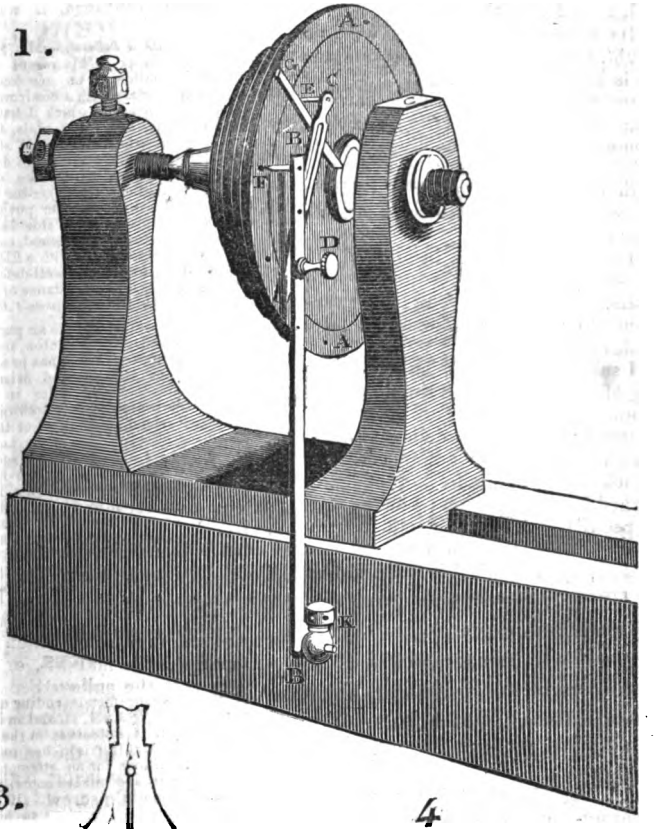
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 346.] SATURDAY, MARCH 27, 1830. [Price 3*d*.

CHEAP AND SIMPLE DIVIDING-APPARATUS.

1.



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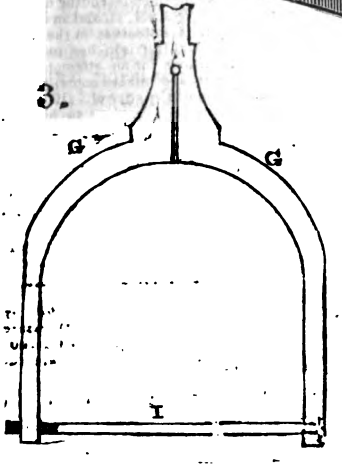

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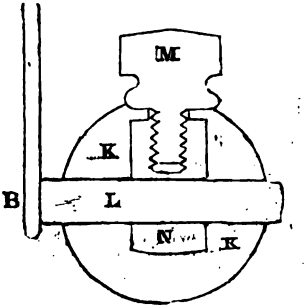

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CHEAP AND SIMPLE DIVIDING-APPARATUS.

Sir,—I do myself the pleasure of sending to the "Mechanics' Magazine" the drawings and description of an apparatus which a German mechanic, living abroad, has affixed to the pulley of my lathe and to the index used with the dividing-plate.

Its cheapness and utility will, no doubt, recommend it as an appendage to lathes in general; but it will be found invaluable to workmen or amateurs who use "*the cutting and drilling-apparatus*," by enabling them to combine great rapidity of execution with the utmost accuracy of division —two important desiderata of no easy achievement.

The apparatus has been used by myself and friends for nearly two years, and has been found by experience to merit the eulogiums I have bestowed upon it.

I subjoin the description and drawing of a very cheap and simple chuck, employed by the German turners for centering pieces of delicate work, which will neither admit of being struck with the mallet nor of being turned between centres; I have found it peculiarly useful for chucking a long piece of ivory, having one end broken, upon which it is required that an ornament or a screw should be cut. I call it the split-chuck, for want of a more appropriate name.

I am, Sir,
Your obedient servant,
S. P. B——s.

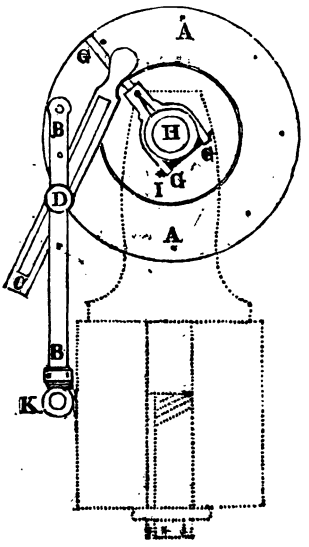
Description of the Dividing-Apparatus.

AA, figs. 1 and 2, is the common dividing-plate on the pulley of the lathe. BB, the spring-dividing index, formed exactly as usual, excepting an addition which will be presently described.

CC is what I call the slide-index, which consists of a plate of brass, having a groove cut through its length to fit the projecting part of a clamping-nut which slides at the back of it, and is not visible in the drawing.

D is a clamping-screw, which passes through any one of three plain holes in BB, and screwing into the above nut, serves to secure CC in any required position.

Fig. 2.



E, fig. 1, is a pin projecting from the back-side of CC, and somewhat shorter than the pin F, which belongs to BB.

GGG, is a little rod of brass which I call the spur-index (fig. 3, represents it on a large scale). Its lower end is spur-shaped, and fits into a groove cut in a ring, which is either driven upon the mandril, or attached by screws to the pulley. See H, fig. 2.

It should be capable of a steady and rather stiff motion in the groove round the axis of the mandril, the degree of stiffness being regulated by means of the little screw I, which also retains it in its place.

If this arrangement be clearly understood, there will be no difficulty in comprehending the manner in which the apparatus works. Let it be supposed, for example, that the work is required to be divided into 8 equal parts; the circle of 80 divisions on the plate will, of course, be chosen; therefore, let the point of the pin F, fig. 1, be first inserted into the hole, No. 80, of the dividing-plate, and let the nearest side of the spur-index G be placed so much beyond the hole No. 10, as

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may be equal to half the diameter of F.

Then let the slide-index CC be loosened: let its pin E, fig. 1, be brought into contact with any part of the outside of the spur-index G; and let CC be firmly secured in its place by the clamping-screw D.

A certain measure corresponding with 10 divisions of the circle having thus, in the first instance, been obtained (between the pins E and F), withdraw the point of the pin F from the hole, No. 80, of the dividing-plate, retaining it however almost in contact with the plate. Now turn the pulley, and with it the index G, until G is felt to touch F, which may then be allowed to spring into No. 10, and the first of the 8 required divisions of the circle will then be completed.

For the second division, move the index G back in its groove round the axis of the mandril until it is felt to press against the pin E, the mandril being kept stationary by the pin F in the hole, No. 10. Then withdrawing the point F from No. 10, bring G again into contact with F, by turning the mandril, and with it the index G, on their axis as before; and, lastly, let F spring into its proper hole, viz. No. 20, which will thus have been brought exactly into a proper situation to receive it.

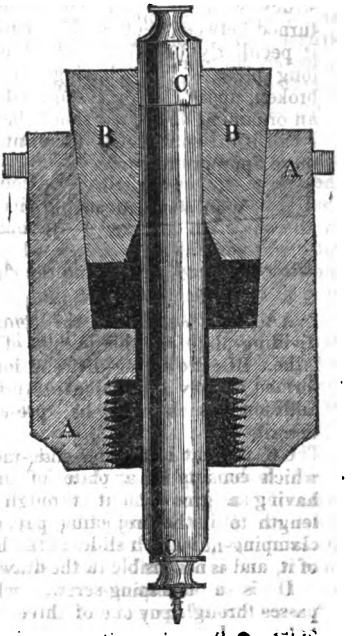
All the remaining divisions of the work may by a repetition of the same process be very easily and rapidly obtained: but I would recommend that the operator, before actually commencing his work, should prove by one or two trials that he has placed the two pins E and F at precisely their proper distance from each other; having so done, no mistake can possibly occur, and he may safely continue his labour, not only without the trouble of counting, but even without looking at the numbers on his dividing-plate.

Fig. 4, is a sectional view of the addition to the common spring-index to which I have alluded. Although not essential to the performance of the operation of dividing, it will be found greatly convenient, and particularly to such persons as possess a crowded dividing-plate; for by its means, no lateral motion of the spring-index BB can take place in the act of withdrawing it from the plate; and, consequently, the accidental deviation into another circle of numbers of the pin F, from the circle originally selected, is wholly prevented.

KK, figs. 1, 2, and 4, is the ball screwed, as usual, to the bed of the lathe, and, as usual, perforated for the reception of the conical pin L, fig. 4, which stands out from the lower end of the index BB. N is a piece of steel, inserted into the ball K, and perforated so as to admit of the pin L passing simultaneously through it and the ball.

A capstan-headed screw M works into this piece, and acting by means of its shoulder upon the ball K, draws the piece N upwards, and, consequently, secures the pin L in the desired situation. The conical pin L, in short, becomes clamped in the same manner as the sliding-centre of a back-puppet.

The Split-Chuck.



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Description of the Split-Chuck.

AA represents the section of a chuck, made of box or other wood, mounted with a ring to prevent its splitting; it should be hollowed out conically, widest at the mouth, and unless you possess a hollow mandril, be nearly as long as the piece intended to be operated upon.

A piece of wood BB, of rather soft texture, is then to be turned conically, so as to penetrate to within a quarter of an inch of its thickest end when driven into the chuck AA. In this position a hole is to be bored through it, rather less in diameter than the piece to be operated upon, and it is accordingly necessary to have several of these cones in readiness, all made to fit AA. The cone, which in no case need be more than two inches long, must then be taken out of the chuck and split equally down the middle, so as to exhibit in each half of its interior a groove of the same depth. In these grooves the piece CC, which it is proposed to chuck, must then be placed (if necessary, enveloped in paper or other soft substance), and the cone be forcibly pressed or driven into the chuck AA, allowing, however, no more of the piece to be operated upon, to project from the cone, than can be avoided.

To centre the piece truly, nothing more is required than to strike with the mallet whichever half of the cone shall be found to act upon the piece in the direction required: the operator will perceive at a glance where the blow is to be applied, and the degree of force requisite, and thus the piece will be brought into and firmly fixed in the desired position, with less trouble than is often required in the ordinary method of chucking, or by employing the usual spring-chuck.

The figure represented supposes the chuck to be applied with a hollow mandril; and the cone may be hollowed out at its farther end (as seen in the figure), when the piecet o be chucked is considerably thicker towards its base than at the end which is to be operated upon.

SLIDE RULES—OAKLEY'S SLIDE RULER'S GUIDE—BAXTON'S ALGEBRA—VYSE'S TUTOR'S GUIDE, &c.

Sir,—Will you give me leave to return my hearty thanks to your ingenious correspondents, G. A. S., and Mr. J. W. Woollgar, for their very able and highly interesting papers on the sliding-rule, in your fourth and seventh volumes; and permit me to request that G. A. S. will be kind enough to perform the promise he made in page 261, vol. iv; viz. that he would at some future time give "*a description of some other rules*, particularly of one called *the improved sliding-rule*, which, though not in general use, is highly deserving the consideration of the practical mechanic, and which, by the assistance of an extra slide, is applicable to almost every purpose of mensuration or arithmetical calculation."*

I wish much to know whether this improved rule, with two slides, can be had of any maker in London, and whether rules with two slides, of Martin's construction (mentioned by Mr. Woollgar in your 7th vol. page 299), can be had in London or not; and also where Routledge's engineers' rule is to be purchased. Some of your readers can doubtless give me the maker's names and the prices at which these rules are sold. I have also to request the same information with regard to Lamb's *concentric circular proportioner*, mentioned in vol. xii. page 23.

I have lately procured Mr. Woollgar's "Companion to the Common Sliding Rule" (see M. Mag. vol. vii. page 389), and I am highly pleased with it. Such a numerous collection of useful formula, in so small a compass, I had never seen; it would, however, have been much more extensively useful, had, at least, one example been given to each formula. The ingenious author would render a most important service, not only to mechanics, but to amateurs like myself, by supplying such a set of examples in your valuable Magazine.

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* Our correspondent will be sorry to learn that Mr. G. A. S. (ears), whose promise he here quotes, died about three years ago. Besides the numerous valuable papers which he communicated to the "Mechanics' Magazine," he edited under the name of Smeaton the last reprint of "Emerson's Mechanics," and supplied all the notes and neat graphic illustrations which distinguish that edition from its predecessors.—Ed.

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I have also lately met with a small publication, called "The Slide-Ruler's Guide," by George Oakley Lucas, schoolmaster, Tisbury, Wilts, which is a work of a very different description. It is, indeed, a most trumpery performance; the poor man neither knows the use of the instrument, nor does he appear to be at all aware of what has been done by others, possessing abundantly more information on the subject than appears to fall to his lot. Take the following specimen of the dignity and perspicuity of his language:—"It (i. e. the sliding rule) is commonly placed *in one of the joints* of the common two-foot rule, of which I think it will be necessary to give a description, in order to explain the meaning of the different tables and figures *thereon*, as I recollect on *first taking to it*, I was greatly puzzled *thereat*." Poor Mr. Lucas!

Again, he tells us that "square timber *is* such as *have* equal bases;" that "unsquared timber *is* such as *have* unequal bases;" and that "round timber *is* such as *have* circular bases!" But enough of this contemptible—this utterly worthless publication.

Give me leave, Mr. Editor, to mention another puny attempt at authorship—I mean "A Treatise on Algebra, containing new and interesting Rules for finding the Roots of Equations, &c. &c." by German Baxton, printed for the author, and sold at No. 2, Church-street, Soho, 1819, 8vo. pp. 208. Having seen the *new* and *interesting* rules much praised in a periodical publication, I was induced to order it, having always been anxious to make myself acquainted with new discoveries and improvements in science: judge then of my surprise, and I may add of my indignation too, (for the book was charged 10 shillings) when I found that these *new methods* were stolen—wholly stolen—and without the least acknowledgment, from the Mathematical Essays of the celebrated Thomas Simpson, of Woolwich, printed in 1740; see pages 81 and 82 of that work, where the truly ingenious author derives the *very same rules* from a fluxionary process, that this impudent plagiarist, German Baxton, published as *his* own. I knew at the first glance to whom he was indebted for his *new methods*, for I had carefully read all Simpson's publications more than thirty years ago, and I was then particularly struck with the method of solving equations given in his 6th essay; indeed I mentioned it at the time to the late Mr. Bonnycastle, of Woolwich, and expressed some surprise that a method so very simple and commodious had not been introduced in any work on algebra. Mr. B., I well recollect, urged the same objection to it as the author himself has done in his preface, page 7; viz. that it could not, with propriety, be placed in an elementary work on algebra, inasmuch as it was deduced from a more exalted branch of mathematics, to wit, the method of fluxions.

In your eighth vol., I find an article headed, "*Error in Vyse's Tutor's Guide:*" there is *no error* here, but there is an *omission*. Rule 3, in that work, for finding the area of a trapezium (see page 233, edit. 5th, 1784, or page 230, edit. 16th, 1821), should stand thus, "or thirdly, *when the trapezium can be inscribed in circle*; subtract, severally, each side from half the sum of the four sides," &c. as in the book, and all will then be right.

And now, Mr. Editor, having got to another book, I should like much, with your permission, to say a few words respecting its history, its errors, and its imperfections.

In the year 1766, Messrs. Anthony and John Birks, masters of the free writing-school, at Donington, in Lincolnshire, published by subscription a large 8vo. volume, entitled, "*Arithmetical Collections and Improvements.*" A second edition, with a few corrections, appeared in 1774. In this work, Messrs. Birks had been at the pains of solving nearly all the questions in "Clare's Introduction to Trade and Business;" some of them of no small difficulty.

In the year 1770, Mr. Charles Vyse, then a schoolmaster in Old Round-court, in the Strand, a speculator, but certainly no conjuror, bethought himself, that if the questions of the Birks's were separated from the solutions, and published in a volume by themselves, and the solutions in another volume, such a work would be more likely to sell among country schoolmasters than the ponderous octavo of Messrs. Birks. He accordingly first published, in the year above-mentioned (1770), the questions alone, and nearly all the rules from the work alluded to, under the name of "*The Tutor's Guide*," to which he added an old-fashioned tract on algebra, copied chiefly from Ward. Three years afterwards, finding the work likely to answer his purpose, he published a second volume, containing the solutions likewise from the Messrs. Birks, under the title of "*A Key to the Tutor's Guide*,"

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but with all the errors of the original authors; and they were not a few. These errors run through *all the editions of the Key*. Even the 16th (1818), which I believe is the last, and which the editor, Mr. Alexander Jamieson, tells us he has "corrected with great attention in every example," is as full of errors as any of its predecessors; and it abundantly proves, *either*, that Mr. Alexander Jamieson is no arithmetician, and therefore incompetent to the task of correcting these errors; *or* if competent, that he neglected to do so, and took the money of his employers for doing nothing.

That I may not be thought to accuse Mr. J. unjustly, I will mention a few of the errors which occur in all the old editions of Vyse's Key, as well as in that superintended by this attentive corrector.

Q. 36. Rule of three is wrong in all the editions of "Vyse's Key," and it is wrong in the "Arithmetical collections" of the Messrs. Birks (see Q. 8, page 282).

Q. 7. Double rule of three the same, but corrected by Hutton and by Keith, above 40 years ago.

Q. 8. Double fellowship the same, corrected in "Keith's Arithmetic," 1st edition, 1788.

Q. 12. Loss and gain; gained *per lb.* printed for gained *per cent*, in all the editions.

Q. 16. Ditto, wrong in all the editions, and wrong in Birks (page 377), corrected by Hutton and by Keith.

Q. 35. Exchange the same, corrected in "Ladies' Diary," 1788-89.

Q. 7. Geom. progression the same, corrected by Keith (1790), and by Molyneux (1794).

In repeating decimals, and in Proportion in decimals, several are wrong, particularly—

Q. 21. (From the "Ladies' Diary," 1755) the solution in Vyse is complete nonsense, in all the editions.

Q. 22. Wrong both in Vyse and Birks.

Q. 67. Compound interest; wrong in all the editions, corrected in "Hutton's Miscellany," 1775.

Q. 19. Prob. 10, mensur. of surfaces, wrong in all the editions.

In addition, subtraction, multiplication, and division of algebra, and in algebraic fractions, *most* of the examples are shamefully incorrect, in *all* the editions, both of the "Arithmetic" and Key;" and in *all* the editions of *both*; the "Binomial Theorem" is so abominably disfigured as to be utterly unintelligible to a learner. I shall mention a few of the errors:—

In the 1st line on page 285 of the "Arithl." (edit. 1821) there are thirteen blunders.

In the 1st 8 *lines*, on page 332 of the "Key" (I refer to Jamieson's *corrected edition*) there are no fewer than 53 *important errors and omissions*, and no edition has ever yet been printed that does not contain, *at least*, 30 *errors in the same* 8 *lines*.

Ex. 15, 17, 19. Simple equations, are all shamefully wrong *in all the editions*.

Ex. 3. On page 337 (Key) is wrong in all the editions, though taken from "Simpson's Algebra," where it is right.

The solutions to Ex. 1, 2, 3. Quadratic equations, are all wrong or defective, owing to the disuse of the double sign ($\pm$) which ought never to be omitted, as both the roots should, in all cases, be exhibited, and their nature explained to beginners.

Then follow 15 questions, copied from "Ward's Guide," where they are all correctly and neatly solved; but in this polished picklock, as well as in *all* the preceding editions, the 2nd, 3rd, 4th, 5th, 6th, 8th, 11th and 12th, are very incorrectly printed—indeed they are complete nonsense.

To the 19th miscellaneous question, at the end, is given a most bungling solution indeed, by a biquadratic equation with all its terms; and the solution to Q. 21, is wrong printed.

Q. 29. Is taken from "The Gentleman's Diary" for 1743, but it is wrong printed in all the editions of the "Tutor's Guide" that I have seen. In the "Key," two solutions are given from the same Diary for 1744—one by trigonometry, the other by algebra; but they are both so disfigured by press errors, as to be of no use to a learner. Besides, the question admits of a very neat solution, and has, in fact, been solved repeatedly, without either trigonometry or algebra: see "Eadon's Arithmetic," page 333, 12mo., 1761, and "Dr. Hutton's Mensuration," Q. 2, page 117, edition, 1770, 4to. Indeed it requires no other instrument than rule 3, prob. 4, mensuration of superficies, in Vyse's own book.

Q. 30. (From the "Ladies' Diary," 1708) is very incorrectly printed in all the editions.

Q. 31. (From the "Palladium," 1770) is very incorrect in all the editions, but more particularly so in the last. 10 and 11 of the "*Diverting Questions*," as they are called, are certainly very improper ones to be introduced in a book of arithmetic, as they require a knowledge of the maxima and minima

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of geometrical quantities; the 10th is from the "Gentleman's Diary" for 1750, and the solution is copied from the Diary for the following year; other solutions may be seen in "Simpson's Algebra, Appendix," prob. 69, and in the "London Magazine" for June, 1768. The 11th is solved in "L'Hospital," in Hayes, in Stone, in the Diaries, in "Emerson's Algebra" (prob. 221) in "Leslie's Geom. Analysis," in vol. vii. of your valuable Magazine, and in several other places.

The 12th (from the "Ladies' Diary," 1748) is a compound exponential equation, and is made nonsense of in all the editions by being misprinted.

The "Appendix" contains a few questions concerning divisors, combinations, magic squares, &c., copied from Donn and Birks, but all "very rudely handled;" indeed they are most ignorantly and most cruelly butchered.

The late Bishop Horsley, speaking of one of Emerson's publications, said it was written "in his (Emerson's) usual manner, that is to say, with great depth of knowledge, with great brevity, and upon sound principles, but without elegance, without order, and without perspicuity;" but what shall we say of the publication of Messrs. Vyse and Jamieson?

I am, Mr. Editor,
Your constant reader,
JONATHAN DAWPLUCKER, Jun.
Edinburgh, Feb. 18th, 1830.

REPLY BY MR. SYNGLEMAN TO MR. GILMAN.

"When a person comes forward, partly in the character of a patentee, and partly in the character of a public benefactor, to claim the credit of having invented something useful to society, with whom is he supposed to deal on the occasion? Is it not with the public from whom he hopes for a reward, in some shape or other, for the service he has rendered?"—ED. M. M. No. 335, p. 351.

Sir,—As I perceive in No. 342, of your Magazine, a letter from Mr. Gilman, in which he expresses his obligations to me for introducing to the more particular attention of your subscribers, Mr. Samuel Hall's patent of the 8th of April, 1824, with which he appears *himself* to be *perfectly familiar*, although he states it "neither suggested the principle nor influenced the arrangement" of the apparatus subsequently given to the public by himself—I will now confer a farther obligation upon him, by introducing to the attention of your subscribers, an extract from Mr. Hall's patent of May 31, 1828, (whether Mr. Gilman has it also in his library, I, of course, cannot know,) which is quite applicable to the sketch I before sent you; only supposing (which requires no great stretch of ingenuity) the cocks in pipe F to remain open, and the blast to be continued; in fact, it seems only to be a more explanatory statement of the patentee's object; it runs thus:—

"I, the said Samuel Hall, do hereby declare, that the nature of my invention consists in the combustion of coal, wood, or other suitable materials, in an artificial atmosphere, greatly superior in density and pressure to the natural atmosphere surrounding the earth, for the purposes of generating *steam, and various gases*, to produce motive-power, &c.

"My method of generating steam, and various gases, is by creating within a part of the apparatus an artificial atmosphere, of much greater elasticity and density than the atmosphere surrounding the earth; in which artificial atmosphere the combustion of fuel is made to take place for the purposes mentioned in my patent.

"The fire so subjected to the artificial atmosphere is to be surrounded by water, and *a portion of the steam* generated by the fire is to be caused to pass *through such fire; the gases thus generated by the combustion of the fuel*, are, as well as the steam which is generated thereby, to be applied in the following manner to produce motive-power. The steam and gases in their condensed state are to be made to act upon a piston working within a cylinder, and they are allowed to escape into the atmosphere after having acted upon the piston in the manner practised with high-pressure steam-engines."

Now, Sir, with the foregoing I will compare Mr. Gilman's distinct statement of *his principle*, which it will be seen is not so perfect as he supposes. He says:—

"I force the products of combustion directly into the water; *not with the expectation* of deriving *power from the gases* that result from the decomposition of the fuel—but with a *view to*

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take from such gases, &c. the heat with which they are supercharged." Very well.

But it is known, that steam at the pressure of the atmosphere (and, when of no power in a high-pressure engine), contains in a latent form 950° of heat, which escaping into the atmosphere, is lost.

It is also known, that the two gases composing atmospheric air (viz. 21 oxygen, 79 nitrogen), have very different capacities for heat, that of oxygen being very great, and that of nitrogen the reverse.

It is also known, that in the operation of combustion, the oxygen for the most part combines with, or is fixed in, the earthy or metallic parts of the fuel, and the caloric it contained is set free.

Now, Mr. Hall, by *using the nitrogen* and other gaseous products, really obtains an elastic, expansive fluid, ready made (if I may be allowed the expression), with a small capacity for heat, and capable of being much expanded by the caloric which is at the same moment set at liberty from the oxygen; and if he could work his engine with nitrogen and carbonic acid gas (of which some, no doubt, will be formed) altogether, and without a particle of steam, it would be his policy so to do.

Mr. Gilman, on the contrary, *takes the heat from those gaseous products*, to which it might be most beneficially applied, and uses it for raising steam, which he afterwards throws away at the pressure of the atmosphere, suffering it to carry with it 950° of latent heat.

Let the public now draw the conclusion. And I trust, that both to you, and your subscribers, I have made it appear that Mr. Hall *does use decomposed atmospheric air, or nitrogen, with high-pressure steam.*

As many of your readers may not be aware, I will add that Mr. Samuel Hall is the inventor of the method of, and machinery for, "gassing" lace and other fabrics, which has so much improved that manufacture of Nottingham, and nearly the whole of which article undergoes that process at his works at Besford, near Nottingham. I have learned, that although his patent bears date May 31, 1828, and he has not yet *intruded himself upon the public*, that he has really an engine not only "in existence" (as Mr. Gilman phrases it), but actually at work.

I hope Mr. Gilman will fully appreciate the "labour" and "trouble" I have taken to oblige him, and not "run a-muck and tilt with all he meets," but use more discretion in future.

I am, Sir,
Yours, &c.
J. SYNGLEMAN.

Derby, March 5, 1830.

MAKING WOOLLEN CLOTH WITHOUT SPINNING OR WEAVING.

Sir,—It may be interesting to your readers to have some farther particulars respecting the scheme of manufacturing cloth by felting, which, as you truly state in your 334th Number, p. 334, was tried in England many years ago, but eventually abandoned as delusive and unprofitable. The English projector was a Mr. Joseph Booth, who tried to establish a manufactory of cloth on this plan at Taunton about 1793 or 1794. The process was kept a great secret, and an Act of Parliament was even obtained, dispensing in Booth's case with the usual obligation on patentees to specify.* But though the process might be kept secret, there was, of course, no concealing the products of it; and these were found so inferior to cloth made on the old plan of spinning and weaving, that the patentee could obtain no market for his commodity. There were several manufactories established in other places under licenses from Booth—one, I think, near Salisbury, and another somewhere in the vicinity of London; but they all shared the same fate.

I am, Sir,
Yours, &c.
TEAZLE.

Somersetshire.

* Not with the obligation to specify; but with the obligation to enrol the specification.—ED. M. M.

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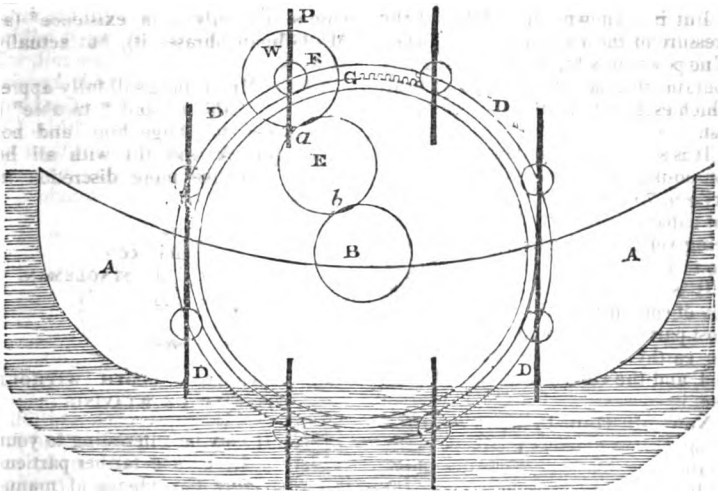
STEAM PADDLE-WHEELS.



Mr. Editor,—In constructing some astronomical machinery, which I made at the age of 14, now many years ago, I employed a principle for producing a parallel motion, which I have since thought might have been advantageously applied to the stupendous water-wheels used in the water-works at London Bridge, for keeping the float-boards perpendicular to the stream; and may still be equally well adapted for keeping the paddles of the paddle-wheel to a steam-packet in an upright position. My method, the following description of which is at your service, will admit of a wheel of a large radius working a proportionate number of paddles a great way in the water, in a line deviating but little from a straight one.

Description.

AA represents the vessel; B, a wheel firmly attached to the side of the vessel, round which the paddle-wheel DDDD revolves; on one of the arms of which are placed the wheels W and E, equal in size and number of teeth to B, taking into the teeth of each other at *a* and *b*. On the axis of the wheel W the paddle P is fixed. Now, it is evident, that as the paddle-wheel DDDD carries round with it the two wheels W and E, the motion thereby produced will be to keep the wheel W and its paddle P always parallel to the fixed wheel B. I may here remark, that the wheel E may be made of a larger diameter than I have drawn it, keeping the two wheels B and W equal. On the axis of W is a pinion F, taking into the teeth of a ring G, which gives the same motion to a pinion on the axis of each of the remaining paddles as that possessed by the wheel W, keeping all of them alike perpendicular. The ring G may be kept in its place by a friction-roller upon each of the arms of the paddle-wheel. The wheels W and E should be placed on opposite sides of the two paddle-wheels, in order to keep the machinery in equilibrio.

I am, Sir,
Your obedient servant,
Dec. 1, 1829. W. RICKETT.

METHOD OF COATING ELECTRICAL JARS.

Sir,—I have never seen any illustrated description of the manner of coating glass jars to form the Leyden phial for electrical experiments; to supply this deficiency, for such it may reasonably be considered, I beg to subjoin a succinct account of a method which I have frequently prac-

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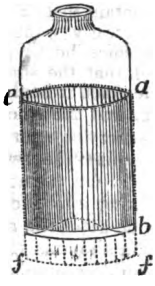
tised, and found convenient in producing neat workmanship.

Bottles having so much smaller an aperture than jars, it is found more difficult to coat them on the inside; with a little care, however, the foil may be laid on even enough. Some resort to filings of brass or iron, but this is a slovenly practice, never answering so well in the end, and a person must be very short of tact to be obliged to have recourse to it. We shall consider the process for coating a small-necked jar in the same order that it would be best to follow. 1st. To prepare the inside; having fixed upon the height to which it is to be coated, cut a piece of tinfoil to the size, measuring it on the *outside* of the bottle, and observe to let it be half or a quarter of an inch short of reaching the bottom, as at *ab*, in the accompanying figure;



also, keep it long enough for the ends to lap over at least the eighth of an inch. 2ndly. Take a brush, and spread good stiff paste over one side of the foil; then roll it up as in the figure below,

keeping the pasted side outermost, and taking care that the roll shall be small enough to enter the bottle without using any force. 3rdly. Take a stick previously prepared for the purpose, shaped as under,

slightly bent at *c*, and at *d* wrapped round with a piece of linen, passing over the end of the stick, and tied at *d* with packthread: let the roll *ab* lie on one side the glass; and with the end *d* of the stick smooth the outer edge on the glass, making it adhere closer by using *c*, unfold the roll, and press the foil as you proceed, keeping it all the time a quarter of an inch from touching the bottom. 4thly. Cut a circular piece of foil larger than the bottom of the bottle, cutting long slits round the edge, as in the sketch,

paste one side, turn it over, and roll it up the same as *ab*, in the second diagram; open it with the stick, and press it even with the end *d*, which will not be difficult, as the slits allow the foil to accommodate itself to any unevenness, and to the channel round the bottom, till it meets the lower edge of *ab*. 5thly. Cut a round piece less in diameter than the outside of the bottom, paste it down, and polish it with the stick. Or, either for the inside or outside of the bottom, small slips of any shape may be economically employed, placing them so as to cover the glass. Lastly. Measure a broad piece on the outside, from the edge of the internal coating to half or three quarters of an inch below the bottom, as seen by the dotted lines *aeff*, in the first figure; lay on the paste, and after wrapping the foil round the bottle, cut slits round the projecting edge; next take the stick and rub it carefully over the whole surface; turn the bottle up and press down, towards the bottom of the phial, every other slit, then proceed with the remaining ones, bending them down too. After rubbing alternately with the ends *c* and *d* of the stick, the foil may be made to appear perfectly even and continuous throughout. Before the cork and wire are fixed into the bottle, it should be kept a few days in a warm place to dry, otherwise a dampness will appear on the glass whenever it is brought near a fire, a

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precaution often necessary before using electrical apparatus.

Regarding the paste it may be as well to say a word, though a quantity may be purchased at a bookbinder's for a mere trifle. If wheaten flour be mixed with *cold* water in a cup to a proper consistency, but not too thick, and then allowed to simmer over the fire in a saucepan for ten minutes, occasionally adding a little hot water, a very strong paste will be the result.

I trust the instructions here given will be found useful, and sufficiently explicit.

I am, Sir, yours, &c.
Stepney, March, 1830. H. D.

THE NATIONAL REPOSITORY.

The opening of this establishment for the present season has been preceded by the publication of a pamphlet, entitled "A Short Statement of the Nature and Objects of the Institution, established for the purpose of annually exhibiting to the public the new and improved productions of the artisans and manufacturers of the United Kingdom." It is said to be "addressed, by permission," to the Hon. G. Agar Ellis, the Chairman of the Board of Management, and may, we presume, be considered in the light of a demi-official vindication of the institution from those objections, which have hitherto weighed so strongly against it in public opinion. Be this as it may, it is but a poor affair, and may be disposed of in a few words.

The writer confesses that the institution has had rather a sorry beginning; but this he tells us is "the common lot of all human undertakings, which in proportion as they are founded *on a good and solid basis*, and calculated to produce beneficial results, are at their beginnings surrounded with obstacles and difficulties, and destined to encounter the stubborn opposition of prejudice." We never knew of a disappointed projector who did not console himself after the same fashion, however foolish his particular project might be, or however well deserved its failure. It is always the stupid public, and never the candidate for its smiles which is in fault. We deny that the National Repository has shared the common lot of *good* institutions. Were it really the case, as its apologist alleges, that the better an institution is, the more opposition it is sure to encounter: then it must be equally true that an institution has only to be as worthless as possible, in order to be certain of immediate success. But who would subscribe to such a satire as this on the good sense and discernment of mankind? It does sometimes occur that good institutions have to struggle through difficulties to prosperity—*per angusta ad augusta;* but the general course of such things is that they succeed *soon*, or not at all. We know of but two cases in which prosperity comes slowly to institutions which deserve it; the first is when they happen to be in advance of the feelings and wants of the age in which they are commenced; and the second, when they are managed so ill, that they would not under such management succeed in any age. But the National Repository, if we may believe its advocates, is by no means in either of these predicaments; instead of being in advance of the age, it is the very thing of all others that is called for and calculated to rectify a thousand existing evils, and is managed moreover to admiration. Now we submit that this is an *impossible* case. We maintain that if it were an institution so greatly wanted, it could not by any chance be so greatly disregarded; and that the supreme lukewarmness with which it has been viewed by our artisans and manufacturers, for whose special benefit it was intended, is the best of all proofs that they want nothing of the kind.

Neither is this conclusion at all weakened by the circumstance that the present apologist of the Repository is pleased to assure his readers that the objections urged against it have been all such as "to disprove themselves." This is but another of the shallow devices, common to defeated schemers. The reasons which prove fatal to their success, are always the silliest in the world. But if "they disprove themselves," how is it that the public have been so blind to their absurdity? and whence the occasion for the vindicatory pamphlet now before us?

The writer proceeds in the same swaggering style to protest that it is not from any apprehension of *danger* to the institution that he has taken up the cudgels in its behalf. Oh, no; the institution itself wants no help; and it is merely by way of amusement that he condescends to take a turn in the lists with its assailants; "although at present there is *no fear* that its opponents should succeed in crying it down, it seems not out of place to add a few remarks, &c. "Crying it *down!*" No, indeed. There is a great difficulty

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to be overcome before one can do that —a difficulty which we imagine its advocates cannot be long in finding out. It must first be cried *up*.

But what are the "few remarks" thus modestly introduced to our notice? It is, it seems, past all doubt that "freedom and strictness of principle" have been "almost entirely banished" from British commerce, by "an unprincipled system of rapine;" that "monopolists, bargain-drivers and swindlers," have got the whole command of the trade and manufactures of the country to themselves; that through the intervention of these nefarious middlemen, the markets are shut to the honest and industrious artisan, and all opportunity denied him of obtaining a fair reward for his industry; and that hence has arisen a system of competition in low-priced goods of inferior quality, which is bringing the character of British manufactures, all over the world, into disgrace, and which, if not "arrested and counteracted," must speedily involve us all in "distress and ruin!" The only remedy for this frightful state of things is, we are assured, *publicity*; and such publicity as the National Repository alone (*risum teneatis*) can give. Let us "bring to light," exclaims this brave reformer, "the secret practices" of these villanous middlemen; let us only "enable the manufacturer to come before the public with his productions, independent of the wholesale dealer and the bargain-shop;" and let every manufacturer who disdains "the ignominious bondage" in which he is now held, only hasten with his "specimens" to the National Repository, and all will yet be well. The manufactures, trade, and character of the country will be redeemed, and England's best benefactor be Mr. Secretary Tull!

Never before, surely, was such a farrago of calumny and nonsense addressed "by permission" to any respectable person out of the walls of Bedlam. That a man should be so grossly ignorant as to rail against a system of intermediate agency, without which, it is well known, no extensive trade could ever be conducted, is barely conceivable; but that he should suppose it to be *possible* for all the merchants of a country to combine against all the manufacturers in it, to the exclusive benefit of the one class and common ruin of the other; that he should stigmatize the great body of British merchants, hitherto so renowned for their honour and integrity, as a set of unprincipled, rapacious, and swindling bargain-drivers, exceeds all experience of human stolidity and assurance. And then for his precious remedy! Our manufacturers and artisans are at present in the hands of griping task-masters, who fleece them at will, and they are to be liberated from their thraldom, and raised to the dignity of free, independent, and thriving workmen, by the exhibition of specimens of their handiwork *in a stable-loft at Charing-cross!* Oh, most lame and impotent conclusion!

As there are some well-meaning, though apparently not very well informed persons in the higher classes, who seem disposed to patronise this preposterous scheme; it may be as well to apprise them, that there is nothing better settled in political economy, than that the best thing people of rank can do for trade is—*to let it alone*. There is not an evil which can arise in the commercial world, in a natural course of things, which will not, in the same course of things, meet with its best remedy. Take the case, for example, on which so much stress is laid by the writer of this "Statement," that of a deterioration in the quality of goods; a fall in quality is as certain to be followed by a corresponding fall in prices, as the sower of bad seed is sure to be the reaper of a bad harvest: people cannot in any long course of dealing be continually imposed upon; nor can it ever be said in a general sense that commodities pass for more than they are worth. There are artificial evils to be sure which must be met by artificial remedies; laws of regulation which demand laws of repeal; but the reform which the wiseacres of the Repository profess to seek, touches none of these; they aspire to "snatch a grace" quite "beyond the reach of art."

But "what *injury*," asks the writer of this Statement, "can a man receive from having a specimen of a new invention or improved production thus exhibited to thousands?" Injury! who ever said that injury could be done by such an exhibition? The question is not whether it will do any injury, but whether it can do all the good which its advocates pretend, and is deserving of all the high consideration which they claim for it? Good it must do to exhibitors to the extent of whatever publicity it can procure for them, in the same way as any other show-room or bazaar is found to do good. No one has ever disputed this, nor would its projectors perhaps have been found fault with, had they even claimed credit for es-

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tablishing as good a bazaar as any in town, though in truth it is excelled by many. But such praise as this, their lofty ambition disdains; they must needs style their show-room a *National* Repository, a *National* Exhibition, where may be seen annually, exposed to public view, "*the* new and improved productions of *the* artisans and manufacturers of *the* United Kingdom," and whence unheard of benefits are to flow to British trade and manufactures. Now this we say it is not, and never will be; it will never exhibit on its shelves a hundredth part of the new productions of British ingenuity in any one year; and will never benefit British trade and manufactures to the extent of more than a dozen or a score of extra orders in the course of a season.

FARROW'S CAST-IRON JOISTS.

Sir,—In answer to an article in your last number, headed, "Farrow's *cast*-iron joists," I beg leave to say, that the writer is in error respecting the nature of my patent, which was obtained for "*wrought* or *malleable* iron-joists" of a peculiar form. With respect to their getting red-hot in case of their being exposed to a fire beneath them, I beg to say the statement I made was not a mere matter of opinion, but the result of actual experiment.

As to the fire at the Argyll-Rooms, I am not surprised at the iron columns becoming red-hot, surrounded as they were by combustible matter, forming a solid mass of fire; whereas, situated as my joists must be, they would only be exposed to the influence of flame, and that on one side only. If J. S. S. is desirous of seeing the experiment repeated, I shall be happy to render him any assistance at one of my forges.

I remain, Sir,
Your obedient servant,
BENJ. FARROW.

Tower-street,
March 23, 1830.

LIST OF PARLIAMENTARY REWARDS GRANTED FOR USEFUL DISCOVERIES, INVENTIONS, AND IMPROVEMENTS.

For Means to facilitate the finding of the Longitude at Sea:—

	£.
Harrison, for time-keepers, 1753	1200
Do. do. 1762	3800
Do. do. 1765	5000
Do. do. 1773	10,000
Mudge, for do. 1777	500
Do. do. 1793	2500
Arnold, for do. 1794	1322
Do. (by his son) do. 1805	1678
Earnshaw, for do. 1799	500
Do. do. 1805	2500
Tobias Meyer, for lunar tables	3000
Euler, for theorems made use of by Meyer	500
Bird, for dividing-apparatus	560
Ramsden, for do.	1000
Total for finding the longitude (in addition to the annual expense of a Board of Longitude for upwards of a century)	34,060
Sir Thomas Lombe, for silk-machinery (the models of which were deposited in the Tower), 1732	14,000
Johanna Stephens, for a cure for the stone, 1739, (of which it is believed no specification is now extant)	5000
Dr. Richard Williams, for fast green and yellow dyes for cotton yarn and thread, 1773	2000
Dr. Irvine, for a method of making sea-water fresh	5000
Carried forward	60,060

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	£.
Brought forward	60,060
Mr. Hartley, to enable him to ascertain the practicability and utility of his method of securing buildings and ships from fire	2500
Mr. Dingley, for erecting a public windmill for sawing timber	2000
Mr. John Blake, to assist him in his scheme of transporting fish to London by land-carriage	2500
Mr. Elkinston, for a mode of draining land	1000
Mr. John Davis, for his method of cleaning smutty wheat, 1800	1000
Mr. Thomas Foden, towards enabling him to prosecute a discovery made by him of a paste as a substitute for wheat-flour, 1801	500
Dr. Jenner, for vaccination, 1802	10,000
Do. do. 1807	20,000
Dr. Cartwright, for wool-combing machinery	10,000
Captain Manby, for his invention of a means of communicating with stranded ships, &c., 1810 and 1812	3250
Mr. Greathead, for a life-boat	1850
Mr. Crompton, for the invention of the spinning-mule	5000
Dr. Smyth, for his discovery of nitric fumigation to prevent the communication of contagion, 1813	5258
Mr. Palmer, for his mail-coach improvements, 1813, (besides an annual pension of £3000 out of the Post-Office revenues)	50,000
	£. 174,918

This is by no means offered as a complete list, and doubtless admits of many additions.

SELF-SUPPORTING DISPENSARIES.

Mr. Smith, an eminent surgeon of Southam, has been delivering, during the past week, at the rooms of the Charitable Institution, in Sackville-street, a series of extremely interesting lectures, explanatory of a plan of Self-Supporting Dispensaries, which has had the honour of originating at Southam, whence it has spread to other towns and villages in the counties of Warwick, Stafford, Northampton, &c.; and bids fair, we are happy to say, to spread over the whole kingdom. The general objects of the plan are to bring the working-classes more generally into the practice of providing for the day of sickness out of their own means; and to lessen the evil of loss of health to individuals, by the combination of numbers, in a system of mutual insurance against the expenses of illness. Mr. Smith has observed, in the course of an extensive practice, that in the great majority of instances in which persons of the working-classes are reduced to pauperism, sickness, with its manifold expenses and deprivations, is the immediate cause; yet strange to say, neither in the list of queries, circulated by the Parliamentary Committee, which was appointed two or three years ago, to inquire into the alarming increase of pauperism, nor in a similar list of queries addressed by the General Assembly of the Church of Scotland to its ministers, is there one which has any bearing on this most fertile of all the sources of pauperism. Of charitable institutions, for administering *gratuitous* relief, we have an abundance. Every parish, too, has its surgeon, from whom medical aid can be obtained for nothing, by those who are unable to pay for it. But, as Mr. Smith most truly and eloquently remarked, "nothing can be of worse tendency

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than to encourage in the working-classes, a habit of depending, in *any case*, on *charitable* assistance. It ought to be the first wish of every independent labourer, (for so every man might be called, who had health and strength to earn his own bread,) to pay for the preservation of his health, as he does for his food and raiment; and to have, like others, the choice of his own doctor—a choice which is in itself medicinal. It was only by cherishing such a feeling to the utmost possible extent, that we can expect to uphold the working-classes in a state of wholesome dependance on their own exertions. Once sneer this feeling down—once make it be regarded as a matter of no consequence by whom or where a sick man is relieved—whether by the parish doctor or at a charitable institution—and one of the most powerful barriers between independent industry and general pauperism will be removed. Every parish had, it was true, its own surgeon, but so also had every parish its *overseer*; and the same inclination which would lead a man to the one, would in the end lead him to the other. Whenever a person ceases to provide for himself, where his health and life are concerned, he speedily ceases to have any care for himself at all, and sinks into one of the most debased, and lost of all the classes of society—those who are cared for at so much per head by public functionaries who care nothing about them." The means by which Mr. Smith proposes to preserve the labouring poor from such a course of degradation and ruin, is to establish in every district a Dispensary, to be supported by the contributions of the labouring poor themselves, and to be attended by all the medical men in the district in succession, who are to divide among them the clear balance of the funds, in proportions to be regulated by the number of patients each has attended. Such is the plan which has been adopted at Southam, Stratford-on-Avon, Coton, and numerous other places, in all of which it has been productive of the most beneficial effects; reducing the poor-rates, and improving, even beyond all expectation, the condition of the poor. So well is it liked among the labouring classes, and in such numbers have they sought to avail themselves of the advantages which it offers, that annual contributions of no more than 3*s.* 6*d.* from adults and 2*s.* from children, have been generally found sufficient to defray all the expenses of a dispensary, and to leave a considerable balance for division among the medical attendants.

The plan of Mr. Smith has several useful ramifications, but we must content ourselves with placing, as we have done, the more prominent features of it before our readers. It was unfolded by its benevolent author with no less ability than zeal; Mr. Smith happily unites to a most enthusiastic desire for the welfare of his fellow men, very sound and enlarged views of the means by which that welfare may be best promoted.

When Mr. Smith concluded his finishing lecture on Saturday last, Earl Vernon was called by the company to the chair, and a plan was forthwith formed for the establishment of a central metropolitan institution for promoting the general adoption of Self-Supporting Dispensaries throughout the kingdom. Earl Vernon and Lord Althorpe consented to act as Presidents, and Dr. Conolly, of the London University, as Honorary Secretary.

SOCIETY FOR PREVENTING LOSS OF LIFE BY FIRE—NEW BUILDING ACT—ANCIENT LIGHTS.

Sir,—On observing that Mr. Baddeley, Jun., intends to favour us with some account of the proceedings of the "Society for Preventing the Loss of Life by Fire," it occurred to me that the Society might perhaps be very beneficially employed at the present time in forwarding the New Building Act, in order to put a stop as speedily as possible to the increase of *funeral piles*, not only in this great city, but throughout the land.

And if inflammable building materials were, as far as possible, prohibited, and the duty on bricks removed, I beg to submit whether it would not be the means of furnishing much additional employment, which at the present time is so much required?

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Brick is perhaps better adapted for the interior of almost every description of house than any other material; and if the duty were taken off, I think it probable that all over the country, even where stone abounds, it would be brought extensively into use.

If so, much of the money which is now sent *abroad* to purchase *fuel for our human immolations*, and the many other disasters which are so frequently occurring by the conflagration of our buildings, would be expended in the purchase of the necessaries of life for the growing population at *home*.

Yours, &c.

C. D. S.

P. S.—In order to determine how near to an "*ancient light*" a new building may be erected, when no distance has been agreed upon, I beg to submit that a line drawn in any direction from the centre of the sill of the ancient light to the top or any other part of the new building, shall not make a greater angle with a horizontal line than 60 degrees. On this principle, the higher any part of the new building is, the greater must be the distance of that part from the light, and no space need be lost which falls under the prescribed angle.

MISCELLANEOUS.

Braconnot's Indelible Ink.—The inventor of this ink, the composition of which is given in the last volume of the Mechanics' Magazine, page 256, has since acknowledged that in ascribing indelibility to it he was too precipitate. For, having subjected it to a fresh trial, he has convinced himself that by successive macerations in chlorine and potash, its colours will be effaced.

Origin of the Steam-engine.—A patent was granted by Charles I. to David Ramsey, Esq. a groom of the Privy Chamber, which is remarkable for containing probably the earliest claim to the invention of the steam-engine. It comprehends nine different inventions, two of which are in these terms, "to raise water from low pits by fire," "to raise water from low places, mines, and coal-pits, by a new method never yet in use."

Lime as Fuel.—Mr. Wallace, of Wigton, has shown that when coals are scarce, lime may be burnt with wood or peat, placed in layers in a conical form, covered with clay, and of five or six yards in diameter, with a funnel of dry furze and peat in the centre of two feet in diameter. The pile is set fire to by the top of this funnel, which will burn down to the bottom and set the whole into combustion.—*Quarterly Journal of Agriculture.*

The Dredging-Machines which have been long in such general use, and contributed so much to the clearing of our rivers and harbours, were invented and patented by a Mr. Israel Pownall, in 1712. Just as he had completed his first engine he died, and leaving only a family of young children, the term of the patent expired before any thing effectual was done under it. Parliament, taking afterwards into consideration the peculiar circumstances by which the benefit of the invention had been lost to the family of its author, passed an Act in 1749, by which the sole property of it was secured to them for 14 years from the 1st August, 1750.

The first Iron Cannon cast in England were made at Backstead, in Sussex (a county which does not now contain a single high-furnace), by Ralph Page and Peter Baude, in the 35th of Henry VIII. (1543). After this they became common.

Stone-Pipes.—In 1734, a patent was granted to John Tuite for making stone-pipes; but nothing was done under it until 1743, when a Mr. John Elwick purchased the patentee's right, and obtained an Act of Parliament for enlarging the term of the patent for 14 years. Mr. Elwick laid out many thousand pounds in improving the invention, but ultimately failed in bringing it into beneficial use. It was revived under patents in 1805, by Sir George Wright; and again in 1810, by Mr. Murdoch. A company was then established, and they made a quantity of stone-pipes for different water-works in Manchester and London; but the pipes did not answer, and were all taken up.

Artificial Hatching.—A singular mode of hatching eggs is said to have been lately practised with great success in the south of France. It consists in putting the eggs into a small basket, and suspending the latter in a small stove, heated by hot mineral water, and turning the eggs every day. The first trial succeeded perfectly, and no failure was experienced in four repetitions of it.

Plate-Glass.—The casting of large plate-glass was commenced in this country in 1773, under the protection of a special Act of Parliament, which gave to a company the exclusive privilege of manufacturing it for a period of 21 years. It has since grown up to a great trade; but the machinery and process have been kept very secret, and are as yet little known. The term of the monopoly has been renewed from time to time by other Acts of Parliament.

INTERIM NOTICES.

If Almaric Clanbrassil's lucubrations have any relation to the objects of our work, the form in which they are offered will be no objection.

The communication respecting "the apparent connexion between the London Mechanics' Institution and Radicalism and Infidelity," came to hand too late to be made any use of this week. We shall be glad to hear what takes place on Monday next.

Communications received from Mr. D. Johnson—Mr. Shires—C. D. S.—C. B——k—Mr. Utting—S. Y.—Mr. Hervey—Amator Scientiæ—Tubal Cain.

LONDON: Published for the Proprietor, by M. SALMON, at the Mechanics' Magazine Office, No. 115, Fleet Street; where Communications for the Editor (post paid) are requested to be addressed.

M. SALMON, Printer, Fleet-street.

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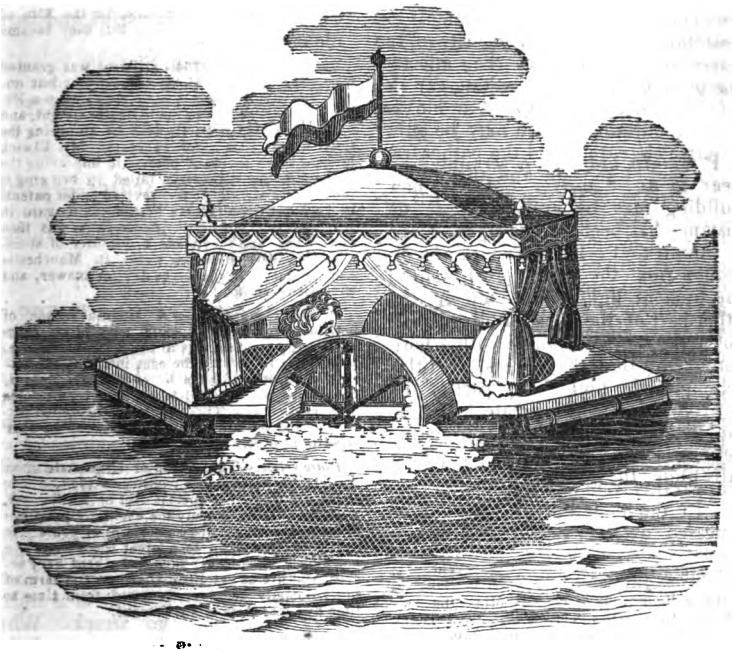
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 347.] SATURDAY, APRIL 3, 1830. [Price 3*d*.

FRENCH FLOATING-BATH, OR AQUATIC PERAMBULATOR.



Sir—When in Paris, about two years ago, I witnessed with considerable interest some successful experiments made on the Seine with a new species of floating-bath, invented by a M. Dejardin, which I am rather surprised has not yet found its way into this country, to the habits of the people of which, it seems to me peculiarly well adapted. It was called by the inventor the "*Baignoire flottante et insubmersible*;" but this title indicates only very partially the distinguishing features of the invention. Had M. Dejardin done no more than make a *floating*-bath also *insubmergible*, he would have done but little; destruction from sinking not being a sort of accident to which floating-baths are commonly subject. But besides being insubmergible, it is ambulatory, and may be used either as a dipping or as a swimming-bath; the great object of it being to combine exercise with bathing (allowed by all medical men to be a great desideratum), and to enable persons to desport even in the most exposed situations of rivers and neighbourhoods with as much privacy as in their own houses. Perhaps it might with more propriety be called the *Aquatic Perambulator*.

The general construction of the bath is represented in the accompanying rough sketch. The body of it consists of a brass-wire trough or car of a quadrangular form, with a wooden bottom, which is fashioned after the

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manner of a ship's bottom, with a keel and prow. All round the rim of this car, and well secured to it by stout brass collars, there are courses of copper tubes called by the inventor, I believe, floating-cylinders, which serve by their superior buoyancy to keep the whole apparatus afloat. Each set of tubes is divided into six compartments, which are hermetically closed at both extremities, so that should any one or two of these compartments get damaged, the general security of the machinery may not be affected. From the rim of the bathing-car rise four pillars, which support an elegant set of curtains, which may be either drawn close, to shield the bather from the heat of the sun and the gaze of the curious, or thrown open when circumstances will admit. The ambulatory or locomotive power of the machine is derived from two small paddle-wheels, one on each side, which are turned by means of handles conveniently placed on the inside within reach of the bather; these wheels are independent of each other, and may be either worked together or separately, like oars. The least force—that even of a youth—is sufficient to work them, and to move the whole apparatus from one spot to another.

In the experiments which I witnessed on the Seine, two of these floating-baths were turned off from the Pont des Arts into the middle of the stream, and propelled apparently with the greatest ease by a single bather in each—now on one side and now on the other—till they reached the Pont Royal. They afterwards went through a number of evolutions with equal success in the basin of the Pont Royal.

The rotation of the paddle-wheels, besides giving motion to the apparatus, and furnishing a most sanatary exercise to the bather, serves to keep the water in which he is enveloped in a constant state of agitation, so that even in the stillest water a person who makes use of such a machine may command the same benefits for which bathing in the sea, and in running streams, is so much recommended by physicians.

As a means of facilitating the acquirement of the excellent and delightful art of swimming, these baths are also well deserving of encouragement. Secure in the protection which they afford, the most timid may here learn to set all the hazards of the liquid element at defiance.

Earnestly hoping that this description of M. Dejardin's invention—imperfect though I must confess it to be—may, through the medium of your universally-circulated journal, be the means of calling the attention of my countrymen to this useful and ingenious contrivance.

I remain, Sir,
Yours, &c.
H. D. R.

Pall Mall, Jan. 9, 1830.

MANUFACTURE OF ARRACK.—PROFESSOR DONOVAN'S "DOMESTIC ECONOMY," VOL. III. OF THE "CABINET CYCLOPÆDIA."

(*From a Correspondent.*)

Mr. Donovan professes to give in this volume a history of intoxicating liquors, and a full account of the art of preparing them. In what manner he has fulfilled his task, in regard to *arrack*, we leave our readers to judge. His account of arrack occupies *eleven lines* only, and notwithstanding its extreme brevity is full of errors. He has committed a gross blunder in stating, that the spirit distilled from the sweet juice which exudes from the flowering spathe of the coco-nut-tree, (mispelt cocoa,) is a liquor very different from arrack. What will the people of Ceylon say of this assertion, when the Professor's volume comes under their notice? The best arrack in the world is made in Ceylon, and solely from the sweet-juice extorted from the flowering spathe of the coco-nut-tree. It is probable, that there are 20 millions of trees in Ceylon, whose produce is chiefly converted into arrack, and the island exports annually a large quantity of this spirit. The term arrack variously corrupted, is employed to designate "spirits," from Dalmatia to the easternmost part of China, and from Tartary, on the north, to the Isles of France and Bourbon. In Dalmatia, arrack is distilled from prunes, and other fruits. In Tartary it is distilled from milk. On the peninsula of India it is prepared

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from toddy, the fermented juice of several palms, but chiefly the coco-nut palm, and the produce of the sugar-cane. We should be glad to know where Mr. Donovan learned that the aqueous-fluid found within the kernel of the coco-nut had ever been *distilled*. Such a circumstance is unknown in the countries of which the coco-nut is a native, or at any rate, where it abounds. Can this be a day-dream of the learned Professor? Mr. Donovan has, with indefatigable labour, consulted every work which contains a fact, however trifling, in regard to the history of *poteen*, while he has neglected to devote any attention to the best accounts of the mode of preparing arrack. We intended to have inserted a list of works connected with the topic, which we would recommend to the Professor's study; for the present, however, we shall content ourselves by suggesting that he should consult a paper on the natural and economical history of the coco-nut tree, which he will find in the 5th or 6th volume of the "Transactions of the Wernerian Natural History Society of Edinburgh," or the notice of this paper which we gave in our 50th Number.

SOLUTIONS OF THE MATHEMATICAL QUESTION PROPOSED BY OMICRON, VOL. XII. P. 251.

QUESTION.—*Given the hypothenuse of a right-angled triangle,* 1000000,000001 *feet, and the base* 999999,999999 *feet: to find the perpendicular.*

By Mr. William Russell, Kilburn.

From 999999,999999,000000,000000
take 999999,999999

Square of base .	999999,999998,000000,000001 B^2
Square of hypothenuse	1000000,000002,000000,000001 A^2
	A^2-B^2=4,000000,000000

The square root of which is 2,000000=the perpendicular.

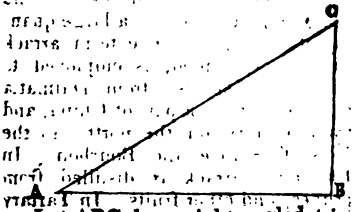
OR: Extract the square root of the product of the sum and difference of the given sides,

Thus . .	1,000000,000000
	999999,999999
Sum . .	2,000000,000000
Difference	2
Product	$\sqrt{4,000000,000000}$=2,000000 as before.

By J. T. H——e.

The square of hypothenuse = 1000000000002·000000000001; and square of base = 999999999998·000000000001; whence $\sqrt{4}$ (the diff.)=2, height of the perpendicular.

By Messrs. Charles Hughes, Forster Webb, and Welsford, Pupils of the Mansion-House Academy, Hammersmith.



Let ABC be a right-angled triangle, B being the right angle; let AC=1000000000001, AB=999999999999. Now, since the rectangle under the sum and difference of two quantities is equal to the difference of their squares ∴ (AC+AB)·(AC−AB) = $AC^2-AB^2=BC^2$=2000000000000 × 2 = 4000000000000 ∴ BC = $\sqrt{4000000000000}$ = 2000000, the answer.

By Mr. Utting.

Let *h* denote the hypothenuse, *b* the base, and *p* the perpendicular; whence, agreeably to the 47th proposition of the 1st book of Euclid, we

Have . . . . . $h^2-b^2=p^2$, whence $\sqrt{p^2}=p$.

Now per question $h^2=1000000{\cdot}000001^2=1000000000002{\cdot}000000000001$

and $b^2=\overline{999999{\cdot}999999}^2=999999999998{\cdot}000000000001$

$\therefore h-b=\quad{\cdot}000002$ and $p^2=h^2-b^2=4{\cdot}000000000000$

whence $p=\sqrt{4}=2$, the perpendicular as required.

The following formula gives more readily the side required.

Let l, m, and g, denote the roots of given numbers, of which m is the *mean* root; l, and g, the less and greater roots equidistant from m.

Now, the difference of the squares of two given numbers, is equal to the lesser root multiplied by twice the difference of the roots, plus the square of their difference.

Or equal to $l\times\overline{g-l}\times2+\overline{g-l}^2=m\times\overline{g-l}\times2$; and, consequently, equal to $\overline{g+l}\times\overline{g-l}=g^2-l^2$.

Now, $g+l$, or $h+b$, as above, is equal to $2000000=$ sum of the roots, and $g-l$, or $h-b=0{\cdot}000002=$ to their difference. $\therefore 2000000\times0{\cdot}000002=4$, as before. This method is much easier than that of squaring the numbers in order to find the difference of the squares, which, in words, "is equal to the *sum* of the *roots* of any two numbers, multiplied by their *difference*."

The *curious* result alluded to by Omicron is, I presume, the continued repetition of the figures 9 and 0, and also of the third side coming out a whole number, whereas the given sides contain 6 decimal places in each side.

In respect to the result of the nines and ciphers, this may easily be demonstrated by deduction from the above formula.* And in respect to the difference of the squares being a *square* number, this result is not peculiar to the above numbers, but comes out the same for all roots equidistant from m, provided the root g is preceded and terminated by an unit, the intermediate figures being ciphers, and the root l consisting of all nines. The root g must also contain an equal number of figures on each side of the decimal point, independent of the unit on the left-hand side; and the root l an equal number of nines on each side of the decimal point. The above result obtains when m is equal

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* In the question under consideration we have given $g=1000000{\cdot}000001$, $=999999{\cdot}999999$, $\therefore m=1000000{\cdot}000000$.

Now $g+m=2000000{\cdot}000001$ and $g-m=0{\cdot}000001$

Consequently $2000000{\cdot}000001\times0{\cdot}000001=2{\cdot}000000000001$

Now $m^2=\quad1000000000000{\cdot}000000000000$

For diff. of squares add $\quad\quad2{\cdot}000000000001$

Sum $=g^2=\quad1000000000002{\cdot}000000000001$

Secondly $m+l=1999999{\cdot}999999$ and $m-l=0{\cdot}000001$

Whence $m+l\times m-l=1{\cdot}999999999999$

Now $m^2=\quad1{\cdot}000000000000{\cdot}000000000000$

Difference of squares subt. $\quad\quad1{\cdot}999999999999$

Square of $l=\quad999999999998{\cdot}000000000001$

In the first case, the difference of the squares of g and m is equal to 2, *plus* the one million millionth part of unity; and in the latter case, the difference of the squares of l and m is equal to 2, *minus* the one million millionth part of unity. Consequently, the sum of the differences between the mean and the two extreme squares is exactly equal to 4, being equal to the difference of the two extreme squares.

The square of any of the following numbers, viz. 101, 1001, 10001, 100001, &c., is always preceded and terminated by an unit; the figure 2 occupying the centre, and having many ciphers on each side of it, between it and each unit, as there are between the units in the root; the squares of the above roots being respectively $=10201$, 1002001, 100020001, 10000200001, &c. Hence the reason is obvious why the nines and ciphers circulate; and also why the difference of the squares is a square number.

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to 10·0, 100·00, 1000·000, &c., m being equal to the mean of the two extreme roots. Suppose two numbers are given, $g=10·1$ and $l=9·9$; their sum is $=20$, and their difference $=0·2$, whence $20\times0·2=4$, the difference of their squares. Again, suppose $g=1000·001$ and $l=999·999$. Now, $g+l=2000$, and $g-l=0·002$; whence $2000\times0·002=4$, the difference of their squares, as before.

In the above question the result would have been the same had the sides been expressed in whole numbers; but, instead of the perpendicular coming out=2, the result would have been=2 millions, the sides of the triangle being in the same proportion to each other in both cases.

[Mr. Russel, and the young gentlemen of the Hammersmith Academy, make the perpendicular 2000000; while Mr. Utting and J. T. H——e represent it as equal to 2. The reason of this difference is that the former suppose all the figures to be integers; while the latter suppose the last 6 figures of the hypothenuse and base to be decimals. Both are equally right in the way in which they have respectively viewed the question. It will be seen, however, by referring to No. 329, where the question was proposed, that the figures employed were all integral numbers; in which case the true answer is 2000000. Mr. Russel's second solution is, we believe, the shortest possible that can be given of questions of this kind.—EDIT.]

PROGRESS OF THE SOCIETY FOR PREVENTING LOSS OF LIFE BY FIRE.

Sir,—It was at the beginning of the year 1828, that public sympathy was excited in an extraordinary manner, by the melancholy and frequent occurrence of loss of life by fire. So awful and so unusually numerous were these calamities about that time, that they became the theme of general conversation; and the subject of fire-escapes was discussed by all persons, and in every place. A very considerable portion of your ninth and following volumes was devoted to the elucidation of the several plans, which had at different times been suggested for the prevention of these accidents.

Among the first who advocated the cause of humanity, was Mr. John Hudson; who, fully aware of the defectiveness of existing provisions, and of the utter insecurity in which the public were placed—and also aware that it was a deficiency of PERSONAL rather than MECHANICAL assistance, that was to be deplored as the cause of all the mischief—suggested in your 237th Number, a proposal for establishing a society, which should effect the desirable object of rendering all needful assistance in case of fire.

It will in no way derogate from the merit of originality on the part of Mr. Hudson, when I say that a similar idea occurred to others; and it is but an act of justice to state, that about the same time that Mr. Hudson's proposal appeared in the "Mechanics Magazine," the following remark appeared in the "Tocsin" (see vol. xii. p. 467):—"Is there not," says Mr. Dudley, "a great want of a humane society in this great metropolis, to promote the best means that can be adopted for the preservation of persons from the destructive element of fire, and to offer rewards to those persons who may be the means of rescuing an unfortunate family, or an individual, from so horrible a death. I should consider that deaths occasioned by fire in London, must be more than treble those occasioned by drowning.* Had I the means, I certainly would endeavour to establish such a society in London." page 56. And again, at page 69, the same writer, speaking of preventing loss of life by fire, says, "I hope we may soon have the pleasure to hear of the establishment of a humane society for the above purpose, which would be far more important to the public than the Mendicity, or any other society. The Royal Humane Society, perhaps, may be induced to extend their charitable views and means to so noble and benevolent an undertaking." There is another person deserving of honourable mention in this place, as the early projector of a society for preventing

* It is but right to attribute this difference mainly to the active exertions of the Royal Humane Society.

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loss of life by fire—it is Mr. Brew, of Ennis. See vol. x. p. 154.

In the plan of the latter gentleman, there is rather too much *chivalry* —in that of Mr. Hudson, scarcely enough. Neither of the plans in their original state was exactly calculated to succeed in practice; but from the two, modified, a most excellent plan of operation might have been formed; and such, I did most devoutly hope to have seen matured. So far, however, from an improved plan having been realized, Mr. Hudson was soon, from some cause to me unknown, induced to forego the most valuable part of those arrangements, which were embodied in his first communication.

As I before stated, Mr. Hudson set out with the (just) conviction, that it was a deficiency of PERSONAL rather than MECHANICAL assistance, which it became the duty of the Society to supply. It was upon this basis that the first arrangements were made. They were principally—the appointment of *twenty-two* persons, in each district of one square mile—instructing them in obtaining, conveying, and applying the *fire-ladders*, with monthly exercises, &c., to render them perfect in their duty.

At page 138, vol. x., an amended prospectus of the society's proposed arrangements was given; in which the twenty-two men, with the fire-ladders, which are very numerous, were reduced to *two men with one set of apparatus*, in each square mile. By this, the *reverse* of the *original position* appears to have been embraced, and has ever since been acted upon.

Feeling as I did a deep interest in the success of the newly-established society, and anxiously expecting the time when I might have personally assisted in the attainment of the society's praiseworthy object, I must say I felt much regret on reading the communication of Mr. Hudson in your 268th Number.

To a communication, which I was then preparing, I prefixed an appeal to Mr. Hudson, showing the discrepancy between his two propositions, and respectfully, but at the same time earnestly, endeavoured to show the impropriety of his last; concluding, by assuring him that if that arrangement were persisted in, the society's efforts would be ineffectual, and prove "*a decided failure.*" This paper, which occupied a portion of your 290th Number, met with no attention from the Society for Preventing Loss of Life by Fire, who held a meeting on the 19th of February, 1829; at which several ingenious fire-escapes were exhibited, with a view to the selection of the *best* for the society's use. A list of these, with detailed accounts of several of them, will be found on referring to your eleventh volume.

About eight months after the establishment of the society, one of your correspondents (Humanitas) inquired "what it had been about, that it had not yet rendered any assistance in case of fire?" This inquiry having been backed by you, elicited a reply from Mr. Hudson, who stated, "that the society had been instrumental in bringing together a variety of ingenious inventions for rendering assistance at fires, and consequently *acquiring some judgment* for the choice of such as are likely to be most useful." Unfortunately, however, this consequence did not follow, as the sequel will show.

It must be pretty evident, from this statement, that the Society for Preventing Loss of Life by Fire were hunting after *machines*, while it was *men* only that were absolutely wanted; they were inquiring—what was the best kind of fire-escape? instead of what was the best mode of insuring the effectual application of those already so abundantly provided? This is the rock on which the society have split—for split they most assuredly have.

There is now laying before me the accounts of several coroner's inquests held upon the bodies of unfortunate individuals who have been burnt to death. To the question—"Do you think the lives might have been saved *if a ladder had been brought?*" the answer has been invariably in the affirmative—"Yes, certainly! without doubt!" And this very fact, with others of a similar import, is related in the last prospectus of the Society for Preventing Loss of Life by Fire.

In no way discouraged by the neglect which my former appeal to the

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society met with at page 357, vol. xii., I entered into a detailed account of the present ample provisions for rendering assistance in case of fire; showed some of the defects of the present system, which rendered these provisions unavailing, and furnished some wholesome practical advice to the society; with plans for their immediately commencing operations, in an effectual manner, although at a limited expense. I also attempted to show the inutility of *one* apparatus only in a square mile; and more especially, the great disadvantages attending the adoption of any fire-escape of an expensive or cumbersome kind. But,

"He who's convinced against his will,
Is of the same opinion still."

And accordingly, soon after the public meeting and exhibition, the society decided upon the fire-escape of Doyle, *alias* Marshall, *alias* Roberts, *alias* four or five others. The choice of this escape, the worst of several bad ones, was the result of "the acquired judgment" of the society; and was in direct opposition to the opinion given of its merits by Dr. Birkbeck, Mr. Hebert, and others. In my paper last alluded to, "I denied *in toto* the applicability of this machine to the purpose of a fire-escape; and, I believe, dear-bought experience will now compel the Society for Preventing Loss of Life by Fire to subscribe to the correctness of my premises. How much money was thrown away upon this machine, I will not tell: suffice it to say, an attempt to construct one *failed*!

Mr. Doyle complained that the artificers had not done him justice in the workmanship. They replied, that the principle required a mathematical accuracy in every part, wholly incompatible with the magnitude of the machine, and with the expense which could be afforded for a fire-escape. So, after bandying the blame from the principle to the workmanship, and from the workmanship to the principle, the thing dropped; the Society for Preventing the Loss of Life by Fire paying the piper.

Foiled in this bold attempt, the society were again compelled to have recourse to their "acquired judgment." And none of the other fire-escapes which graced the exhibition being "quite the thing," a new one was concocted, in every way worthy of its place, as a substitute for Doyle's.

A *wild*-er contrivance has not been resorted to for many a day. Davis's one-horse waggon-ladder (the prototype of Gregory's improved) is portability itself, compared with the apparatus now in the possession of the society.

I once intended to send you a drawing of this superb piece of mechanism, but unwilling to put you to the expense of a useless engraving, I shall confine myself to a verbal description. Such of your readers, however, as will take that trouble, may see a drawing of it in the Royal Exchange.

The apparatus then consists of a strong four-wheeled waggon, with a raised platform; upon which Mr. Wild (for that I believe is the maker's name) not having the fear of the Lord Chancellor before his eyes, has placed one of Gregory's PATENT (*otherwise portable*) DERRICKS, see vol. xi. p. 213. Upon the top joint of the derrick, is firmly secured a wooden cradle, capable of holding three or four persons. This cradle is slowly raised or lowered by a winch and chain; while a second movement gives any horizontal inclination that may be required.

When the machine is *in ordinary*, the derrick lies horizontally upon the elevated platform, together with a very pretty staircase (!) for the descent of persons from the cradle, which can only be lowered to within about fifteen feet of the ground. The acknowledged weight of the apparatus is about fifteen hundred weight; it looks more. It is drawn by *one horse*. When this machine was first sent home, even the society were ashamed of it; and it was afterwards altered, and reduced to the weight I have mentioned. The expense incurred in the construction is upwards of eighty pounds.

If the Society for Preventing the Loss of Life by Fire can engage an astrologer of the nineteenth century to calculate and foretell the occurrence of fires, and so enable them to

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place their apparatus in front of the devoted premises in perfect readiness the day before, then, and not till then, will the society accomplish the end for which they became united. Notwithstanding the strength, stability, and costliness of the apparatus, with which the society have provided themselves, the public are as far from deriving any benefit from their labours as they were ten years ago.

The society have received donations from some of the fire-insurance companies, as well as from individuals, and have squandered away funds* amply sufficient, if properly applied, to have enabled them to commence and continue active operations, on an extended scale. For at least twelve months after they commenced operations, subscriptions would have been obtained in greater abundance, and might indeed have been solicited with a much better grace than at present.

At the close of a lecture at the London Mechanics' Institution, a few weeks since, on the inventions of the Chevalier Aldini, Dr. Birkbeck stated that "during the past twelve months no steps had been taken to prevent a recurrence of loss of life by fire." This shows pretty clearly that Dr. Birkbeck, who is one of the committee of the Society for Preventing Loss of Life by Fire, has had but little influence over their proceedings, and is fully aware of the uselessness of all their past arrangements.

I am aware that some of my remarks upon the society are severe, but let them pass; I have no other object in view than to endeavour to rouse the dormant energies of those who have undertaken a public enterprise; and well will it be for them if they listen to the still small voice which now accosts them, *rather* than await the screams of midnight agony. They have been labouring in the work of humanity, without effecting the least portion of good; and it is now high time that they should retrace their steps and begin anew: fresh arrangements must be made, and fresh plans acted upon.

Let them form stations of single individuals, and render the *fire-ladders* accessible to them; fire-escapes of an *improved* description will be an appropriate after-thought. As many of these individuals would be volunteers, the expense of this arrangement would be but trifling in the first instance; but it might be augmented and improved with increasing funds.

For myself, I am as enthusiastic in the cause as ever, and still cherish a hope, though faint it be, that the Society for Preventing Loss of Life by Fire will yet prosper. The way to do so, "is plain as way to parish church."

In conclusion, I would wish the society to remember that—

"A fool on something great at times may stumble,
And consequently be a good adviser;
On which, for ever, your wise men may fumble,
And never be a whit the wiser.
Yes! I advise you, for there's wisdom in't,
Never to be superior to a *hint*—
The genius of each man, with keenness view—
A spark from this or t'other caught,
May kindle quick as thought,
A glorious bonfire up in you."

I am, Sir,
Yours respectfully,
W. Baddeley, Jun.

March 24, 1830.

* I must except five pounds given to a person who exerted himself at a fire at Kingsland. But this is the *only reward*, I am aware of, having been given.

PROTECTION OF STEAM-BOILERS FROM CORROSION.

M. Van Beck, of Utrecht, states in a communication to the *Annales de Chimie*, that his experiments have led him to the conviction, that Sir Humphry Davy has committed a serious error in his Bakerian Lecture of 1826, in recommending the use of zinc or tin for the preservation of steam-boilers in which sea-water is used. He has found that tin, far from preserving iron, is, on the contrary, preserved by it; and concludes that "a piece of tin introduced into a boiler, instead of diminishing the danger of explosion by preserving the boiler, would powerfully contribute to its destruction."

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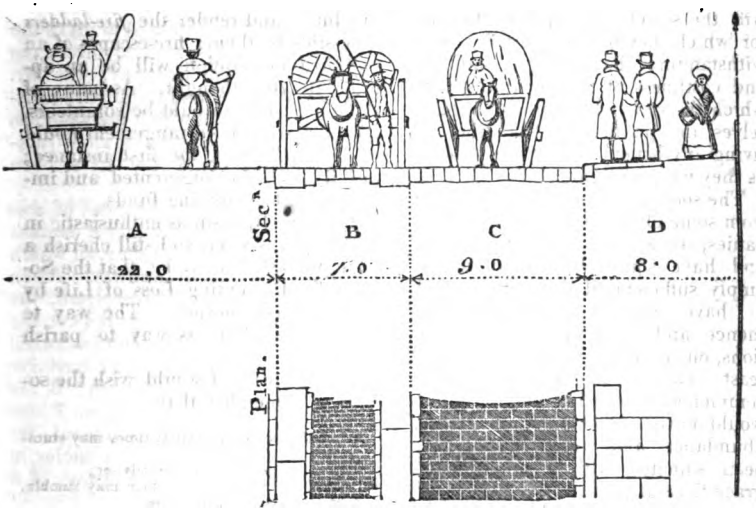
STONE TRAMWAY, COMMERCIAL-ROAD.



In consequence of the Commercial-road forming the line of communication between the East and West India Docks, and the great commercial warehouses in the eastern parts of London, the traffic of heavy goods upon it is greater than on any other road about the metropolis. The excessive tear and wear to which it is thus subjected, and the large outlay constantly required for repairs, induced the Trustees of the road, about three years ago, to come to the resolution of laying down a stone tramway, after the manner of the ancient Roman pavements, of which specimens are still to be seen in Milan, Florence, Sienna, and other Italian cities; that is, a carriage-way with two courses of large stone blocks for the wheels to run on, with a space between them for the horses, laid with ordinary gravel.

Besides the great gain which such a roadway offered in point of durability, it promised advantages, in respect to increasing the ease of draught to the horses employed upon it, and cheapening proportionally the carriage of goods between the docks and the city, which caused the plan to be very favourably viewed by the Directors of the Dock Companies, and obtained for it, as far as needful, their cordial co-operation.

The term *tramway*, as we have before had occasion to explain to our readers (vol. xii. p. 132), has been hitherto generally used to designate that description of iron railway in which flat rails or tram-plates, level with the ground, are employed: and between a tramway of iron and one of stone there is no difference, as respects their position in a road. The benefit derived from having the rails flat and level with the ground is, that carriages of all descriptions, and with all sorts of wheels, can avail themselves of the facilities they afford at pleasure—passing on to or quitting them without inconvenience, and crossing them without injury.

The preference which has been given in the present instance to stone over iron, has been chiefly dictated, we understand, by the consideration, that in rainy or frosty weather iron are more slippery than stone rails, and more likely to cause injurious accidents. The reality of this advantage is not to be disputed; but we suspect it has been greatly overrated, and will be found in the end rather dearly purchased.

Stone, at such a distance from the

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quarry as London, must cost considerably more than iron; and, but that its liability to wear faster may possibly be counterbalanced by the waste through oxidation to which iron is subject, we should say, that its durability must also be much less. One important advantage which iron-plates will always have over stone-rails is, that they form but surface-coverings to the stone supports beneath them, and as they get worn, may be from time to time easily renewed; while a solid block of stone must be allowed to wear away to a depth equal to *many iron-plates* before any thought of renewing it can be entertained: losing in proportion as it wears down, that coincidence with the level of the road, which constitutes the chief recommendation of a tramway. Among the remains of Pompeii there is a stone-way of this description, the blocks of which are worn *half through into ruts.* What has been permitted once among an opulent people, may be permitted again.

Tramways, whether of stone or iron, are open to this common objection, that they present a larger rubbing surface than edge-rails, and are more liable to be clogged with dust and mud; but we are not prepared to say that in a case like the present, where celerity of conveyance is less the object desired than an easy draught at any rate of speed, and where the line is short and the traffic on it likely to be constant, this objection is one of much weight.

The original intention of the Commercial Road Trustees was to lay down two tramways, that is, a going and a returning line—one on each side of the road; but as the heavy traffic is chiefly *from* the Docks *to* London, it was thought sufficient by way of a first experiment to construct one tramway only on the south side of the road. It was also determined to limit this tramway, in the first instance, to the space between the end of Berner Street, Whitechapel, and the West India Docks—the loads from which are, from the nature of West India produce, the heaviest that traverse the Commercial Road. The distance between these two points is about 2 miles.

On Saturday last the tramway to this extent was finally completed, and opened to the free use of the public.

The engineer employed to make the necessary surveys, and to direct the execution of the tramway, was Mr. James Walker; and the highly satisfactory manner in which the work has been done, proves that a more judicious choice could not have been made.

The engraving at the head of this notice exhibits a transverse section and plan of that side of the road which includes the present tramway. When the whole design is completed, the other side will be, in every respect, the same. A, is part of a Macadamized road in the centre for light carriages and horses, 22 feet in width; B, the stoneway for heavy waggons, 7 feet wide; C, a granite pavement for stage-coaches and similar vehicles, 9 feet wide; and D, a footway of 8 feet in breadth.

Subjoined to this notice we give also a longitudinal section of the whole line from the W. I. Docks to Whitechapel, with which we have been kindly favoured by Mr. Walker. From this it will be seen that it consists of a series of inclined planes, rising, with one or two exceptions, towards London; but that the total average rise in the 2 miles is only 1 in 274, and that for more than four-fifths of the distance the inclination is not more than 1 in 250. Generally speaking, therefore, the road may be considered a level one in the popular acceptation of the term, and well adapted to exhibit the facilities of the railway system to good advantage.

The stone employed has been all of granite; the greater part obtained from Aberdeen, a considerable portion from Herm Island, some from Leicestershire (Mount Sorrel), and some from Guernsey and Jersey. The positions which the different descriptions of stone respectively occupy are marked in the section of which we have just spoken; but we believe they have had these positions assigned to them without any reference to their comparative qualities. It was necessary, in order to give the contractors for the supply of the materials (the respectable firm of Messrs. Free-

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man, of Milbank), the benefit of an open market, that they should be left at liberty to furnish granite of any one of certain specified descriptions, and hence the variety which prevails. The sorts which the contractors have supplied in the greatest abundance are allowed, on all hands we believe, to be the best.

The stones are all of one form and size; not tapering towards the bottom, according to the old, absurd practice, but perfectly square and dressed so as to fit closely to each other. The interposition of any substances between them which might cause a disturbance of position, whether from top or bottom, is thus prevented. And to prevent any subsidence from the general level, the stones are laid on a firm bottom of cement and gravel; such a bottoming as that exhibited in the case of the stoneway at Pompeii, which after the lapse of unrecorded time, remains almost perfectly level, while the superincumbent stones have been worn half through.

Of the superior facility of draught realized by this tramway, we were on Saturday presented with some experimental demonstrations, well calculated to signalize with due effect, the opening of this important work for public use. Six carriages were loaded as follows:—

The first, a low truck, with two large blocks of Portland-stones, surmounted by a number of dock labourers and sailors; total weight, 10 tons.

Second, a waggon with sugar hogsheads and men—weight, 10 tons.

Third, ditto with curb-stone—weight, 8 tons.

Fourth, ditto with paving-stones—weight, 7 tons.

Fifth, ditto with curb-stones—weight, 7 tons.

Sixth, ditto with Portland blocks—weight, 7½ tons.

The first and second carriages were fitted with the patent cylindrical wheels of Messrs. Jones and Co., of the superiority of which over every other sort of wheel hitherto brought into use, the present experiments furnished the most convincing evidence. The other carriages were of the ordinary sort with dished wheels. The first carriage was drawn by one horse, of superior size and action; the second by two smaller horses; the remaining four by one stout horse each.

The carriages started *en suite* from the West India Docks, and reached the city end of the tramway in 34½ minutes, being at the rate of about 4 miles per hour. The first carriage, with the wheels of Messrs. Jones and Co., was about fifty yards ahead of the rest—though carrying three tons more than any of the waggons with dished wheels. The horse, too, seemed not in the least distressed, while the horses of all the waggons, with dished wheels, had to labour hard—even with their lighter weights—to preserve the distance they did.

On a common road it is considered good work if a horse can draw one ton at the rate of four miles per hour; but we see that here this rate was exceeded by *nine* tons, with the help of Messrs. Jones and Co.'s wheels, and *six* and *seven* tons with the ordinary dished wheels.

In a report of experiments made by Mr. Walker, in March 1829, the substance of which we subjoin, he estimated that six tons, gross, would be a proper load for a horse to draw on this tramway from the docks to Whitechapel; that is with the ordinary dished wheels. That this was no exaggerated estimate the present experiments sufficiently prove. We make no doubt that by using Jones and Co.'s wheels, at least eight tons may be drawn with ease.

Mr. Walker, in this report, calculates the friction on a stone tramway to be 12½lbs. to the ton, or $\frac{1}{180}$ of the whole weight moved, and "this friction," he adds, "is not more than upon the best constructed edge-railway." The recent experiments, however, on the Liverpool and Manchester Railway, recorded in our last volume, p. 315, 461, show that however correct this statement may be in regard to stone tramways, it does injustice to the edge railway, on which the friction is much less.

Mr. Walker's Report of Experiments in 1829.

"The experiments were made upon the space between the West India Dock gate and the first turnpike upon the Commercial Road, with a very good town-waggon belonging to Messrs.

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Smith and Sons' Distillery, and a stone-truck belonging to Messrs. Freeman. The dust had been swept off the tramway in the morning.

"The distance is 550 feet, of which 250 feet nearest the dock-gate rises 1 foot, or 1 in 250; and the other 300 feet rises about 2½ feet, or 1 in 116.

"The whole rise in the 550 feet is 3½ feet, or 1 in 155.

"The gravity of 1 ton upon the lower length is therefore 2240lbs divided by 250, or nearly ..... 9½lbs.

"Upon the upper length it is 2240lbs. divided by 116, which is equal to ..... 19⅓lbs.

"And the average of gravity upon the whole length is 2240lbs. divided by 155, or ..... 14½lbs.

"EXPERIMENT 1.—The general average resistance of 4 tons gross (viz. waggon, 1 ton 16 cwt. and goods, 2 tons 4 cwt.) as ascertained by means of a spring weighing-machine, was 127lbs.

"From which if we deduct the gravity of 4 tons, or 19⅓lbs. multiplied by 4, say ..... 77lbs.

"There is left for the friction of 4 tons ..... 50lbs.

"Which gives for the friction of 1 ton 12½lbs. or $\frac{1}{180}$ of the whole weight moved.

"This friction is not more than upon the best constructed edge-railway. I consider that the greater size of our wheels, and there being no flanch, compensate for the roughness of the stones (from their being newly laid) as compared with an iron-railway.

"EXPERIMENT 2.—A pony 12½ hands high, weight 4½ cwt., drew upon the upper part, and afterwards upon the lower part 6 tons (gross). I was not aware that the difference of inclination of the two parts was so great, or he should have gone over the upper length again; he had done it more than once before.

"Taking, therefore, the upper part, or the rise of 1 in 116, the pony's exertion was,

Gravity, 19⅓lbs. multiplied by 6 tons, or ..... 116lbs.
Friction, 12½lbs. multiplied by 6 tons, or ..... 75lbs.

Making together ..... 191lbs.

and 191lbs. divided by 12½lbs. (the friction of 1 ton) gives 15 tons.

"The pony's work, therefore, was equal to 15 tons drawn upon a level road.

"EXPERIMENT 3.—The waggon (loaded as in the preceding experiment), being turned round and started by the pony's exertion, ran down the whole length to the dock-gates with increasing velocity (the pony not drawing it), and for a distance off the tramway, before it could be stopped. Consequently, the average fall of 1 in 155 exceeded the resistance by friction.

"EXPERIMENT 4.—A powerful horse (weight, 14 cwt.) drew 12 tons, gross (the waggon and truck loaded), from the West India Dock gate to the turnpike at the rate of 4 miles per hour.

"Taking, then, the upper length, or a rise of 1 in 116, we have

"Gravity, 12 times 19⅓lbs. or ..... 232lbs.
"Friction, 12 times 12½lbs. or ..... 150lbs.

"Making together ..... 382lbs.

and 382lbs. divided by 12½lbs., gives 30⅝ tons.

"The horse's work was, therefore, the same as if he had been drawing 30⅝ tons upon a level.

"The full average work of a horse per day is 150lbs. moved 20 miles; consequently, the *pony* was exerting *one-fourth* more than the average work of one horse through the day, and the horse was doing the work of two-and-a-half horses. The horse appeared to go easily, but the exertion was, of course, too great to be continued for any considerable time, so as to form a basis for general calculation.

"Upon the whole I think the conclusion is, that if the road were level, the work of a London draught-horse upon the tramway would be 16 tons (gross); but as the Commercial Road rises towards London, a deduction must be made from this for gravity, the amount of which depends upon the inclination of the road, and is common to all kinds of roads and railways. Therefore, taking all things into consideration, I am of opinion that 6 tons (gross) from the Docks to Whitechapel, and a greater weight from Whitechapel to the Docks, may be considered a proper load for one horse on the tramway."

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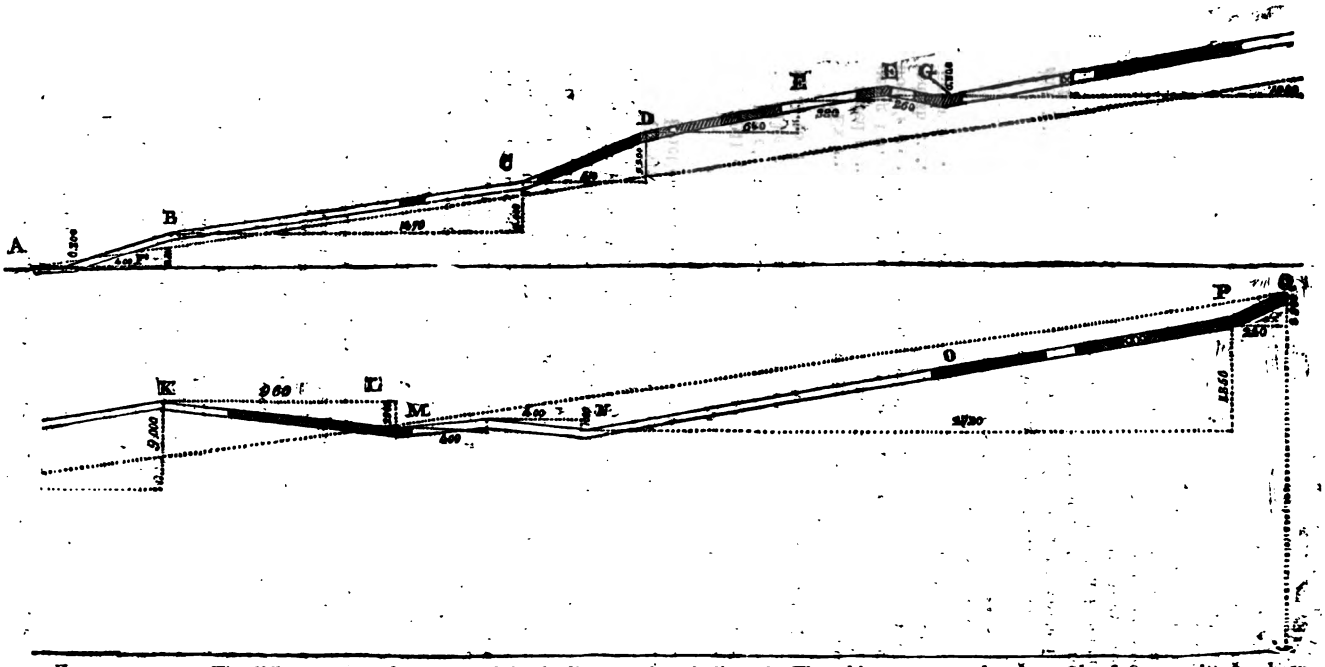

EXPLANATIONS.—The different sorts of stone used in the line are thus indicated—The white spaces mark where Aberdeen granite has been used; those shaded and crossed with lines inclining to the left where Herm stone is the material. Guernsey stone is denoted by cross-lines inclining to the right; Jersey by × × ; Leicestershire by o e o. The inclination of the different slopes is as follows:—1st. Slope from the West India Dock entrance at A to a, rise $\frac{1}{800}$. 2nd. From a to B, Poplar-gate, rise $\frac{1}{114}$. 3rd. From B to C, Three Colt-street, rise $\frac{1}{247}$. 4th. From C to D, Limehouse-bridge, rise $\frac{1}{9}$. 5th. From D to E, Mill-place, rise $\frac{1}{137}$. 6th. From E to F, Regent's Canal-bridge, rise $\frac{1}{113}$. 7th. From F to G, Brunton's factory, fall $\frac{1}{121}$. 8th. From G to K, 230 feet beyond Stepney Causeway, rise $\frac{1}{120}$. 9th. From K to beyond L, Jamaica-street, $\frac{1}{113}$. 10th. From last point to beyond M, John-street, rise $\frac{1}{260}$. 11th. From last point to near the George N, fall $\frac{1}{260}$. 12th. From N to Cannon-street-gate, and onwards to Berners street, rise $\frac{1}{210}$. 14th. From Berners-street, to the end of the road, rise $\frac{1}{7}$.

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REPLY OF "A PRACTICAL ENGINEER" TO MR. GILMAN'S "REFUTATION."

Sir,—The commencement of Mr. Gilman's refutation occupying about four columns of your valuable journal, scarcely deserves notice, as not bearing upon the main subject. I must, however, notice some parts of it. Mr. Gilman asks whether it would not be more just to convict first, and then condemn; and says, it is my principle to hang a man first, and try him afterwards. To this I would reply, that it is clear upon what principle I have acted, as I have at present only convicted him, and have not condemned him at all; and to show my tender mercy I would not vote for his being hanged either before trial or afterwards, but pronounce that the sentence of this court is, that he be not hanged, but birched—and birched well.

Mr. Gilman gives his *ci-devant* partner, Mr. Sowerby, a tremendous character; with this I have nothing to do; so leave Mr. S. to make his bow, and return thanks for himself.

Mr. Gilman acknowledges himself ashamed of his bantling, which was born April 13th, 1825. Had he contented himself with only doing that, I should have been satisfied with his reason for not mentioning it in his narrative, and not have said more about its beginning as follows:—"*In* 1826 my attention was directed to the best and most economical method of generating steam, &c.:" for I assure you I would never kick a man when he is down. But as he still seems to retain an overweening fondness for this hopeful offspring of his brain, by asserting that "no difficulty was experienced in passing water through the immense length of tubing without converting it into steam;" I beg to say that I deny his statement to be correct, and to assert that it is impossible to pass only *such a quantity of water as Messrs. Gilman and Sowerby's four retorts would be capable of evaporating* (which must be what is meant in the patent) through such an immense length of tubing without converting part of it into steam. No doubt water may be passed in such quantity, and with such velocity, through a very great length of tubing as not to be converted into steam; but the quantity necessary to effect this, would be so great, as to inundate the retorts, and pass over into the working cylinder for the most part in the form of water, and not of steam. Will Mr. Gilman pretend to say that this was meant by his patent? If not, where is the ground for his stating, "thus you see, Mr. Editor, this censor is not quite infallible, although he has presumed to ascend the judgment-seat."

We now come to the facts of the case. Mr. Gilman begins with the following paragraph and quotation—"We will now proceed to his" *fearless assertion, that fuel, under combustion, was never subjected to a pressure of so much as one pound, much less of three hundred, to the square inch, above the pressure of the atmosphere.* Shall I express myself, sir, too strongly, if I call this an impudent attempt to throw dust into the eyes of your readers by thus extracting the text and withholding the context? Let us give them both as follows, and then see how the matter stands. What I said was this—"But in reply to his statement that from 200 to 300lbs. per inch pressure were employed BY IT (Mr. Gilman's Generator), I will fearlessly assert that he never did, nor never could do any such thing; so far from his doing that I challenge him to prove that he ever, WITH THAT APPARATUS (AND IN THE WAY HE DESCRIBES), subjected fuel to combustion under a pressure of so much as 1lb. much less of 300lbs. to the square inch above the pressure of the atmosphere." Mr. Gilman, it will be observed, wishes to make your readers believe that I have made a *general* and *unqualified* statement, "that fuel under combustion was never submitted to a pressure of so much as one pound, &c.:" whereas I have most distinctly qualified the statement by saying, that "*with that apparatus, and in the way he describes*, I will challenge him to prove that he ever subjected the fuel to combustion, &c." This, he says, however, "taken as a whole, is not altogether intelligible." Is it not indeed? I think not one of your readers, except our "Civil Engineer," will find it at all *un*intelligible.

Mr. Gilman then proceeds thus—"This sentence affords another specimen of his purpose, misrepresentation, inasmuch as it affirms that which was never asserted, namely, the *amount* of pressure; my narrative only states *great pressures*, and must be taken, of course, as comparative." What! does he not mention the *amount* of pressure? Does he not in his narrative say, "The drawing, fig. 1, represents the external appearance, and fig. 2, a section of the apparatus or generator which was of great strength, on account of the various, and sometimes great pressures, from 2 to 300lbs. per inch employed, &c.?"

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After this, surely no one need be surprised at any thing Mr. Gilman may say.

I am now about to quote a piece of information so important, that we, perhaps, may allow it to compensate for all Mr. Gilman's peccadillos—"But without further observation I will describe the means employed to supply the fire with air, when every person can judge what degree of credit is due to this fearless assertion. There *were* two blowing cylinders, different in size, worked by a steam-engine, making about 30 strokes per minute. The contents of the large cylinder were compressed into the small one, the piston of which delivered it to the fire-chamber. Now, as neither the air-blown in, nor the products of combustion had means of escape, except through the tubes and valves, into the water under the pressure of the steam in the Generator, I presume this fearless assertion has received a sufficient refutation."

A sufficient refutation!!! What in the world does the man mean by talking of one blowing cylinder passing air into another blowing cylinder, and of that delivering it again into the fire-chamber? I recollect an old friend of mine, a first-rate tea-drinker, after having taken his seventeenth cup, and finding it rather weak, said to the lady at the table—"I think, madam, you might spare yourself the trouble of transferring the water from the kettle to the cup through the medium of the tea pot, by pouring it into the cup direct." Now, I assert that there is no more use in transferring air from one blowing cylinder to another in its way to the fire-chamber, than there is in passing water into a tea-cup, *via* the tea-pot that has no tea in it. I perceive how Mr. Gilman has been floundering with the idea of blowing from one cylinder into another. He thinks it bears some analogy to the plan of my friend (as Mr. Gilman calls him), Mr. Wolf, of using high-pressure steam in one cylinder, and transferring it from thence to another, to be used as low-pressure steam, with condensation. Now, sir, I challenge Mr. Gilman to prove, by respectable witnesses, that he ever did work two blowing cylinders *in the way he describes*, either *by a steam-engine, making 30 strokes a minute*, or any other number of strokes: mind I do not say that he *could* not do so, but I say he *did* not do so. I speak advisedly, and not at random. I put Mr. Gilman's veracity to a test (for this could not be done in a corner), of which, if I am wrong, he can easily avail himself, to the benefit of his own character, and to my discomfiture and disgrace.

Having disposed of the two blowing cylinders, we now come to the main thing, *Gilman's Generator*, and I must request of such of your readers as wish to understand this matter thoroughly, to refer to your 330th Number, page 259, which contains fig. 2, showing the section of the generator, and to place that engraving side by side with the part of Mr. Gilman's refutation in your 345th Number, which relates to the joints, as this appears to me the best mode of making the point intelligible.

I must remark that after reading this part of Mr. Gilman's *refutation*, I could not help availing myself of Mr. Burchell's little expressive word, and exclaiming FUDGE; and that it is indeed fudge I will now proceed to demonstrate. I will, in the first place, show you in a moment, and prove beyond all cavil, the justice of my charges against Mr. Gilman. In one part of the above explanation of the joints, he says, "First, then, the ends of the cylinders were accurately turned, and the cover of the bottom nicely faced to joint with the cylinders." Now, a little farther on he says, "And the iron surfaces were brought to somewhat less than the sixteenth of an inch of being in contact." How soon he forgets that he has stated that these surfaces were *accurately turned and nicely faced!* Now, really, does not this show the whole of his statements to be fudge—aye! much worse than fudge? Of what earthly use could it be to *accurately turn* and *nicely face* surfaces that are to be kept "somewhat less than the sixteenth of an inch of being in contact." Let me remind your readers that Mr. Gilman says these surfaces *were*, not that they *might be* accurately turned, &c.

If Mr. Gilman is not now ashamed of himself, I shall quite despair of him; and shall therefore only further remark, as far as relates to the joints, that in the section, as shown in No. 330 of his generator, there is no appearance of *angular grooves* or *annealed copper-wires* to form the joints of the outer cylinder, nor the bottom of the inner one. There is, it is true, the appearance of a circular groove at the top of the latter. Mr. Gilman wishes to make it appear that the joints and bolts have sadly perplexed me. But if it would not appear to savour of vanity and egotism, I could tell him that I not only know what joints and bolts *will* do, but I know what will

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not do, and I think he is now aware of that.

With respect to the two following paragraphs of Mr. Gilman's refutation, in which he quotes Captain Brown's experiments, explaining the expansive qualities of wrought and cast-iron, I can only again say it is all *fudge, fudge, fudge*; and repeat the assertion in my paper contained in your 334th Number, that a vessel of two feet in diameter, with the bottom and cover attached to it by only 12¾ inches square bolts in the manner shown by the drawing, is no more capable of bearing a pressure of 200 or 300lbs. on the square inch, without suffering the steam to escape, than it is of bearing a pressure of 2000 or 3000lbs. per square inch.

Mr. Gilman's last paragraph is somewhat singular, as he quotes the name of Mr. Horn to prove, not that his joints *would* hold, but that they *would not* hold!!

In conclusion, I submit, that with all *due* deference to the veracity of Mr. Gilman, not a word that he has said in his defence ought to be received (I will even say believed) upon the principle of law, that secondary evidence is never admitted in a court of justice, when primary, and of course better evidence, is forthcoming. For, instance a description of a deed is never admitted while the deed itself is in existence, and can be produced. If, as Mr. Gilman has stated, his apparatus *was executed*, is *now in existence*, and that with it various and great pressures, from 200 to 300lbs. per inch *were* employed, let him, as I have formerly suggested, show the apparatus, in operation, to competent and respectable persons, instead of venting his spleen, and indulging in invective.

I am, Sir,
Your obedient servant,
A PRACTICAL ENGINEER.

MISCELLANEOUS.

The original Musket, and even the lighter fusil, which was the first improvement upon it, must have been a most ponderous and unmanageable weapon, for in its pristine state it required full a quarter of an hour to load and discharge it; it was always fired on a rest; and even so late as his own days Montecuculi insists on the necessity of providing the musketeers, to make their aim the steadier, with this forked support.—*United Service Journal for April.*

Artificial Light made use of by Birds.—The following extraordinary account of the Lozia Philippina, a bird of the Philippine Islands, is given by Dr. Tinton, an American writer—"It constructs a curious nest with the long fibres of plants, of dry grass, and suspends it by a kind of cord, nearly half an ell long, from the end of a slender branch of a tree, that may be inaccessible to snakes, and safe from the prying intrusion of the numerous monkies which inhabit those regions. At the end of this cord is a gourd-shaped nest, divided into three apartments; the first of which is occupied by the male, the second by the female, and the third containing the young; and in the first apartment, where the male keeps watch while the female is hatching, is placed on one side a little tough clay, and on the top of this clay is fixed *a glow-worm, to afford its inhabitants light in the night time.*"

Lead Pipes.—The mode of casting pipes o lead, for the conveyance of water under ground, was first invented by Robert Brock, one of the chaplains of Henry VIII., and carried into practice with the aid of Robert Cooper, a goldsmith of London.

Economy in Leeches.—Dr. Salle, of Fontainbleau, proposes as a means of economizing leeches, to cut them in two while in the act of suction! He affirms that notwithstanding this operation, the adhering part of the animal will continue to draw blood as long as may be required. *Credat Judæus, non ego.* Z.

Fulling-Mills.—Lord Coke says, "there was a new invention found out heretofore, that bonnets and caps might be thickened in a fulling-mill, by which means more might be done than by the labours of fourscore men, who get their livings by it. It was ordained by an act of 7 Edward VI. c. 8, that bonnets and caps should be thickened and fulled by the strength of men, and not in a fulling-mill, for it was holden inconvenient to turn so many labouring men to idleness." Had parliament always acted on this benevolent, but most erroneous notion of the interests of the people, in what a slow condition would the arts have now been amongst us?—Z.

INTERIM NOTICES.

We understand that a requisition has been signed by upwards of 130 members of the London Mechanics' Institution, calling on the committee to convene a general meeting to take into consideration the circumstances to which we alluded in our last, as indicating an "apparent connexion between the Institution and Radicalism and Infidelity." It may be as well, therefore, to leave the matter where it is at present.

We have received Mr. Gilman's rejoinder to Mr. Syngleman; but—one at a time.

"A Practical Engineer" will find a letter for him at the place to which the last was addressed.

Communications received from Mr. Taplin—Mr. Oram—A County Chemist—A Subscriber, J. O. B.—An Old Subscriber—Mr. Latham—Mr. Jennings—R. O. L.—A Young Trussmaker—S. J.

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Mechanics' Magazine,
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 348.] SATURDAY, APRIL 10, 1830. [Price 3d.

COOPER'S ROTARY FIRE-ENGINE.

Fig. 1

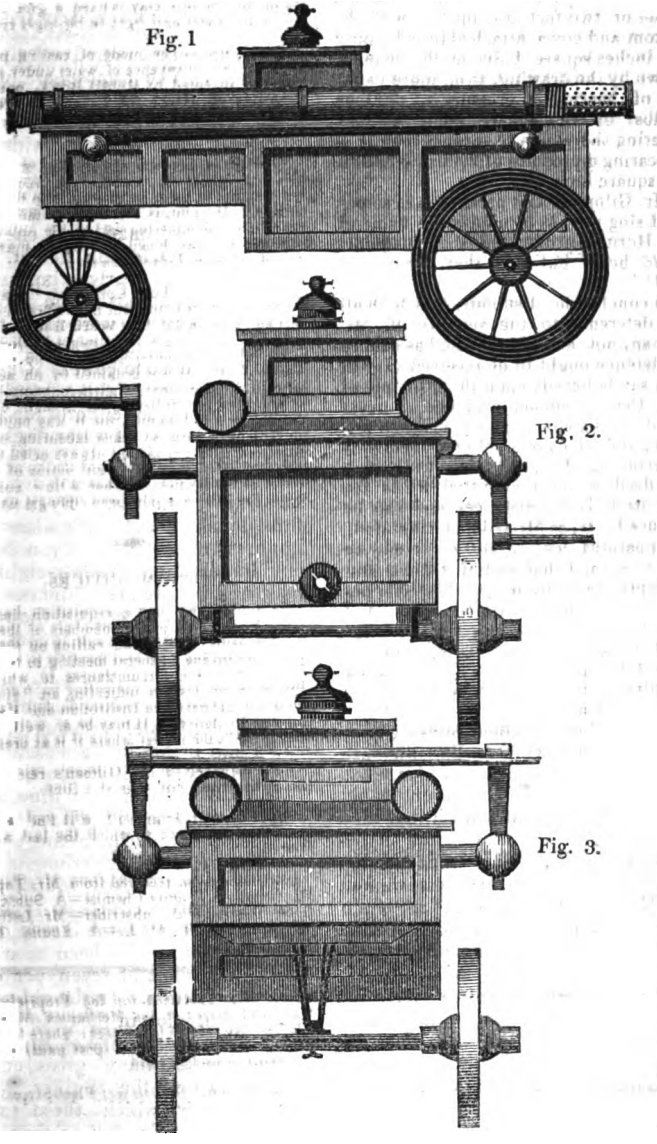

Fig. 2.

Fig. 3.

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COOPER'S ROTARY FIRE-ENGINE.

A company has been recently established by an act of incorporation from the legislature of the State of Vermont, (U. S.) under the title of the "American Hydraulic Company," for the manufacture of a new description of fire-engine (on the rotary principle), invented by a Mr. John Milton Cooper, which, if all be true that is affirmed of it, is vastly superior to those in common use. We are assured that Mr. Cooper's engines, compared with others, are more simple in construction, more durable, of less weight, and less liable to get out of order; that they raise double the quantity of water, and discharge it in a more condensed volume; that with proper care they are proof against the effects of frost; that they can be worked with one half the usual power, and cost only one half the usual expense. Nor do these representations rest merely on the authority of the inventor and his partners themselves. Professor Silliman states, in the last number of his journal, that he has "had *good opportunities* of seeing these engines in full operation;" that he "has been *much impressed* with a conviction of their superiority over those in common use," and does not think the proprietors "have overrated" their powers. To this decided and weighty testimony in their favour, the professor adds a narrative of some experiments made with engines, on Mr. Cooper's plan, of different sizes, which seem to place this superiority beyond all doubt.

"An engine on the rotative principle, of the size marked No. 11, worked by sixteen men, with eleven inches lever, discharged through a four-inch pipe, more water than three eight-inch cylinders, with nine inches stroke, and fifteen inches lever, worked by thirty-four men—and as much water as four six and a half-inch cylinders, nine inches stroke, worked by thirty-six men with twenty-four inches lever. This experiment was made at the corporation yard, in the city of New York, in September 1827.

"The same engine with twelve men, eleven inches lever, threw more water than two engines (New York and Hydraulion), in the city of Boston, worked by thirty-six men, with twenty-four inches lever. This experiment was made in State-street, Boston, in September 1827.

"No. 7, rotative engine with twenty men, exerting an estimated power of thirty-five pounds per man, with seven inches lever, threw from an inch pipe one hundred and fifty-six feet horizontal, and one hundred and nine feet in height. The atmosphere was at the temperature of 42°, and perfectly calm.

"No. 2, rotative engine with eight men, exerting an estimated power of fifty pounds per man, threw from a half-inch pipe, one hundred and forty-eight feet horizontal, and one hundred and three feet in height. The atmosphere was nearly calm, and the thermometer at 53°. The two last-mentioned engines were made to discharge a large quantity, without particular reference to power. One constructed for power alone, would probably much exceed either of the above.

"The quantity of water discharged by a No. 11 engine, is five hundred and twenty-five gallons for each hundred revolutions. By a No. 7, three hundred and four gallons each hundred revolutions. By a No. 3, one hundred and twenty-eight gallons each hundred revolutions.

"In the No. 11 engine, the revolving cylinder is thirteen inches long, and eight inches in diameter, and the surface acting upon the water is forty square inches. In No. 7, the revolving cylinder is twelve inches long, six and a half inches in diameter, and it has a surface of thirty square inches. The No. 3 cylinders are nine inches long, five inches in diameter, and eighteen square inches acting surface.

"The result of experiments upon it as a pump proved satisfactorily, that the only deduction from the power applied, after the inertia of the water and pump had been once overcome, was short of seven per cent., including friction. In the old pumps ten per cent is lost in the reciprocating motion alone, exclusive of friction."

Professor Silliman gives engravings of two of the engines, Nos. 3 and 7, with which these experiments were made, but as they exhi-

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bit merely their external appearance in different positions—a description of their internal construction being reserved till the proprietors have "secured their invention abroad as well as at home"—it may suffice for every purpose of so limited an illustration, to lay before our readers one set of these figures only. On our front-page we give those descriptive of the engine, No. 7. Fig. 1, represents a side-view of the engine, with the suction-hose upon the carriage, and without the cranks. Fig. 2, a hind-view, and the situation of the cranks when in the working position. Fig. 3, a front-view, with the cranks reversed, as when the engine is moved from place to place.

To Professor Silliman's own account of this invention there is subjoined a copy of a printed paper issued by the American Hydraulic Company, from which we gather the following particulars, explanatory of the means by which the extraordinary results exhibited in the preceding experiments are obtained:—

The means by which it raises double the quantity of water.

"The fact is self-evident, that in working the old engines, to discharge the chamber or cylinder *once*, the piston must pass *twice* through it; an ascending stroke to create a vacuum, and a descending one to force the water. Half the time is consequently lost. In the rotative, on the contrary, it is equally evident that a continued vacuum is created, and a continued discharge effected by one and the same operation."

The causes of its being worked with one-half the power.

"The air-vessel is totally dispensed with;* and the power is applied *directly* upon the water. It operates on no more than it discharges. On the other hand, as a consequence of the alternating motion of the piston engines, twice the surface is acted upon, and the *friction*, of course, is comparatively *two-fold*. This is not all. The power necessary to overcome the *inertia* of the water is both exerted and suspended at every stroke of the piston. But in the rotative the current flows instantly, continuously, and uninterruptedly."

It is comparatively proof against frost.

Because "a single revolution of the rotative discharges the ice that may have collected on the surface exposed, and an effective operation is not retarded for a moment. Those acquainted with the old engines, know, by sad experience, the evils of frozen valves and obstructed pistons, and that it is necessary to resort to means of *thawing out the machine*, or to suffer it to remain useless, even at times of fire."

It discharges a more condensed column.

"Because it dispenses with the air-vessel. It is apparent to the man of chemical science, if not to the common observer, that water, *in the form of spray*, thrown into an intense flame, is instantly decomposed (giving its oxygen to the carbon to increase its ignition, and its hydrogen to augment the volume of flame), and, instead of diminishing, increases its fury. The advantage of the rotative herein consists in dispensing with the air-vessel. In the old machine it is indispensible: yet, notwithstanding its use and importance to them, it constantly imparts a portion of air to the water discharged, and thus far produces the evil complained of."

* "Fire-engines are generally made with one or more piston-cylinders, placed either perpendicularly or horizontally, with solid or valve-pistons playing in them, with a reciprocating motion. In this way one object is accomplished, viz. the discharging of water to a much greater distance than it can be thrown with simple power. But with this advantage there is a disadvantage, inasmuch as the stream being operated upon directly by the power, gives, in its motion, an exact representation of the mode of its application; consequently, the stream is as unequal as the force applied, and, at every change of the piston, stops. To remedy this defect, a vessel filled with air is placed in the vicinity of the piston-cylinder, and the water, ere its final discharge, is forced into the bottom of this vessel, and then allowed to escape. As the pipe, through which the water makes its final escape, is generally much smaller than the piston-cylinder, consequently the motion of the piston will produce compression on the water at every stroke, while the air, in the air-chamber, becomes compressed in like manner. The advantage, then, of the air-chamber is, that this compressed air operates upon the water as a spring, and exerts its power during the suspension of the other power, while changing the brakes."

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Mr. Cooper is described by Professor Silliman as "a young man of a vigorous intellect and strong inventive powers, who (living until that time in the forest) by a happy thought hit upon this fine invention, before he had ever heard or seen the word hydraulics, or knew that there was such a thing as atmospheric or hydrostatic pressure!"

MOMENTUM OF FALLING BODIES—REMARKS BY "S. Y." ON MR. HARRISON'S PAPERS.

Sir,—I would not ask for space in your valuable little work to answer Mr. Harrison's paper in No. 343, were it not for *one* charge which he makes, that is of too serious a nature to be passed over unnoticed. He says, p. 4, "It is a false assertion that the *square* of a *velocity* is said to be *equal* to a double *pressure*: because no such thing is said, neither is it the case." I think I shall prove that the paragraph I alluded to when I made this observation, means—*if it means any thing*—that the square of a velocity is equal to a double *weight*; I erroneously used the word *pressure*, instead of the word *weight*. Mr. Harrison may make the most of the error.

My remarks in No. 314 were not intended as a criticism on Mr. Harrison's paper in No. 308, but merely to hint to him that he was writing in a manner which made him appear possessed of little knowledge of his subject, or guilty of writing very carelessly. My remarks were certainly unstudied; for they were not meant to correct his blunders, but to direct his attention to them, that he might correct them himself. Instead of doing this, he *confirms them* in No. 343, and as they might give your juvenile readers some trouble for no purpose, I must undertake the unpleasant task of exposing the faults of another; but Mr. Harrison will forgive my controverting "false principles," as he acknowledges "nothing can be more indispensible."

In his paper, No. 308, page 324, he says he told Mr. Wynn that the momentum of bodies is in the compound proportion of their weights and velocities; and in his second letter he told Mr. Wynn, that the force of the blow would be as the weight of the hammer multiplied by the height it falls from: or, in other words, his opinions on the subject were in so conveniently unsettled a state, that he could take up which ever side of the question suited his purpose. He then goes on to say, "so far from *the velocity being in a greater ratio* than the heights from whence bodies fall, *it really is only in half that ratio*:" in the next page he informs us, that "the velocities of falling bodies are in the subduplicate ratio of the perpendicular heights of their fall." And in No. 343, page 3, he tells us, that "subduplicate ratio and half the ratio are the same thing." As this is giving pretty good proof that he does not understand the magnitudes of ratios; and as, when he talks of *velocities*, or *squares* of *velocities*, being *equal* to *pressures* or *times*, he proves that *he does not know what ratio means*, I will endeavour to enlighten him on the subject.

"RATIO. The relation which one thing has to another of *the same kind*, in respect to magnitude or quantity."—*Johnson's Dictionary*. "Ratio is a mutual relation of two magnitudes of *the same kind* to one another in respect of quantity."—*Euclid's Elements*, book 5. "By ratio, is meant the relation which one quantity bears to another, with respect to magnitude. It is evident that this relation can exist only between quantities of a similar kind; thus a *number* must be compared with a *number*; a *line* with a *line*, &c. &c.; and it would be absurd to compare a certain number of *feet* with a certain number of *pounds*, &c. &c."—*Bridge's Algebra*, p. 121, 5th edit. "The *magnitude* of a ratio being measured by the *number of times*, one quantity is contained in another."—(Ib. p. 122) "The ratio of the square root of a, to the square root of b, is called the *subduplicate ratio* of a to b."—(Ib. p. 126.)

Suppose the ratio of $c : d$ is in half the ratio of $a : b$, then $\frac{c}{d} = \frac{a}{b} \div 2$; but if $c : d$ in the *subduplicate ratio* of $a : b$, then $\frac{c}{d} = \frac{\sqrt{a}}{\sqrt{b}}$. Let $a = 64$ and $b = 4$; then the ratio of $a : b = 64 : 4$, and (as above) the *magnitude* of the ratio is $\frac{64}{4} = 16$; half the ratio, or a ratio of half the magnitude is of course 8, and the subduplicate ratio is $\sqrt{64} : \sqrt{4}$, or $\frac{\sqrt{64}}{\sqrt{4}} = \frac{8}{2} = 4$.

Mr. Harrison may perhaps now perceive that the subduplicate ratio and half the ratio are not *exactly* the same thing; and he may possibly see the absurdity of talking about times being equal to velocities, &c. &c., which is what I meant to point out to him, and

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which remains the same, whether they are *times*, *parts* of times, or *multiples* of times. Can Mr. Harrison divide a time by a velocity? I know he can divide the *abstract number* which represents the *time* by the like number which represents the *velocity*; but Mr. Harrison did *not mean this*, for if he had, he would have seen the imperative necessity of telling us the *terms in which each was to be taken*. But he leaves us to take them as we please; we may take his times in *centuries* or *seconds* as we choose, and so of his velocities, &c. &c. But perhaps these assertions of Mr. Harrison, are some of his "strict matters of fact," which will render it "unnecessary for him to consult the authors I refer to."

If any one can comprehend the reasoning in the paragraph, p. 325, No. 308, beginning, "If we suppose," and explain in what way it warrants the conclusion which Mr. Harrison has arrived at by means of it, I shall be obliged to him, for I confess I can do neither one nor the other. I am not cavilling about *terms* but *meanings*, and I defy any one to give a *rational* explanation of the passage which was to make his case "*perspicuous to all*," and which, he says, *has done so*.

We will now pass to the paragraph beginning, "This law is also," &c., p. 326, No. 308; it says, "a shell thrown from a mortar attracts the earth with a force equal to its weight every instant of its range, and consequently the earth not only ceases to be pressed by the weight of the shell during the time, but the attraction by which its ascent is continually retarded, acting at the same time with equal force, *the tendency of the earth towards the shell* is equal to the weight of the latter, whence the effect is doubled, or equal to twice the weight of the shell. To compensate this effect (or to produce an equal effect in an opposite direction), the recoil of the mortar gives a *pressure*, over and above its weight, *equal* to the *square* of the *time* or *velocity* of the ascent." Now here is an effect produced by a *pressure* caused by the recoil of the mortar (which recoil is itself caused by the discharge of the shell) equal to *twice the weight* of the shell. But this *pressure* is "equal to the *square* of the *time* or velocity of the ascent." I learned at school, that "things which are equal to the same are equal to one another" (*Euclid's Elements*, book 1); and here we have a *pressure* equal to a *double weight*, and also equal to the *square of a velocity*; and therefore "the *square* of a *velocity* is said to be equal to a *double weight*," or to a "double pressure!" The absurdity is equal; and Mr. Harrison may take his choice of the two expressions.

The plain truth is, Mr. Harrison *knew so little of his own meaning*, that when it was put in a different form he declared it a "*false assertion*," and that *no such thing was said!* We are then told, that "the force with which *it* falls" (that is the *mortar*, although the writer *most likely* means the *shell*), "supplies the *very same quantity* which is lost in the descent." Gentle reader, have patience. Here a body by its *fall supplies* the same quantity of something which is *lost* by its *descent*. This is "confusion worse confused;" and what is worse than all, *the attempted description has no resemblance to the real state of things*, which is this: the two bodies (the earth and shell) are kept together by their mutual attraction; the ignited gunpowder expands and forces them asunder, and *the earth leaves the shell as well as the shell leaves the earth*, until the force with which they were separated is exhausted by the opposing forces, which are the mutual attractions, resistance of the air, &c. The two bodies then come to a state of rest, and immediately afterwards approach each other, and meet in *exactly the same point at which they separated*. But the space the *earth* moves through is to the space the *shell* moves through, in the inverse ratio of the quantity of matter in the earth to the quantity of matter in the shell, and is of course *inconceivably small*. But what motion, or tendency to motion there is, is as I have described it (when the shell is fired *perpendicularly*—when not, the state of things is modified); and I appeal to Dr. Gregory, or any natural philosopher, to confirm or contradict the truth of my statement.

March 17, 1830.

(To be continued.)

AMERICAN ALMANAC AND REPOSITORY, OF USEFUL KNOWLEDGE, FOR THE YEAR 1830.

We have recently received this interesting volume from Boston—the first of a series which, if it meets with the encouragement it deserves, will be as long as the duration of American independence itself. It is a work calculated to excite and receive universal attention. Our printers will examine it and commend the printing, both on account of its neatness and accuracy; the stationers will look closely into it and commend the paper, as doing great honour

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to American manufacture; and the general reader will find it to abound with curious and useful information.

It commences, like other almanacs, with a calendar—which is very scientifically arranged, and from the cursory examination we have been enabled to bestow on it, we should say, compiled with considerable accuracy. The astronomical information is more full and complete, by far, than in any almanac with which we are acquainted, "White's Ephemeris" alone excepted; and there is a special appendix of *corrections* of distances between the centres of the sun and moon, for every third hour (Greenwich apparent time), made upon our unfortunate "Nautical Almanac." The astronomical matter occupies altogether 49 pages, forming Part I. of the almanac.

Part II. is devoted to information relative to the calendar, and is taken principally from our Useful Knowledge Diffusion Society's "Companion to the Almanac," for 1829. It extends to 48 pages.

Part III., in 40 pages, includes miscellaneous directions, hints, and remarks. Among these are some very interesting agricultural notes, by the illustrious Washington, comprising directions to the manager of his farms—further directions for cultivating a farm near Mount Vernon—his rules and tables for the rotation of crops, and extracts from one of his agricultural journals. There are also some very sensible remarks on the use of fruits, distinguishing between the *improper*, and the *proper* and beneficial use of them.

Part IV., in 38 pages, exhibits "Statistical and General Information respecting Foreign Countries." This is extracted principally from the "Companion to the Almanac," before referred to.

Part V., in 130 pages, contains "Statistical aand other intelligence respecting the United States." This part is divided into four sections, which relate respectively to "Colonial Statistics," "Statistics of the Revolution," "Statistical and other particulars respecting the United States generally," and "Statistical and other information respecting Individual States." This portion of the book is, to us, peculiarly interesting, and, we need not hesitate to say, will be found extremely instructive; as it exhibits in a small compass the progress from the commencement of the American struggle for independence to the present, of these our trans-Atlantic brethren in population, freedom, riches, intelligence, and general science. Were we to follow our inclinations, we should quote very largely from this department of the work; but as our so doing would in some cases draw us too far and too long from the immediate objects of our Magazine, we must select but a few particulars, and content ourselves with expressing a hope, that the substance of the statistical information relative to America presented in this almanac, will soon find its way into some of our popular synopses of geography.

We will first extract a few particulars from the American *Red Book*, that our readers may judge in what splendour the salaries of these Republican functionaries enable them to live.

Salaries of the Cabinet and Heads of Departments.

President, salary.....	25,000 dollars.
Secretary of State.....	6000
Secretary of the Treasury	6000
Secretary of War.....	6000
Secretary of the Navy..	6000
Postmaster-General	6000
Vice-President	5000

Judiciary.

Chief Justice, salary....	5000
6 Associate Justices, each	4500
Justices of the separate states, from	1000
to 1800 dollars per annum.	

We are next presented with some interesting information respecting the

Expense of the Revolutionary War.

In 1775 and 1776..	20,064,667 dollars.
1777	24,986,647
1778	24,280,438
1779	10,794,621
1780	3,000,000
1781	1,942,465
1782	3,632,746
1783	3,226,586
To Nov. 1, 1784..	548,526

These were issues from the treasury, and were independent of the *debt* incurred during the war, which amounted to 42,708,010: thus the total estimated expense of the war was 135,193,703 dollars.

Population of the United States in 1820.

Maine	298,335
New Hampshire	244,161
Massachusetts	523,287
Rhode Island	83,059
Vermont	235,764
Connecticut	275,248
New York	1,372,812
Delaware	72,749
New Jersey	277,575
Pennsylvania	1,049,449
Maryland	407,350
Virginia	1,065,366
North Carolina	638,829
South Carolina	502,741

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Georgia	340,987
Kentucky	564,313
Tennessee	422,619
Ohio	581,434
Louisiana	153,407
Indiana	147,178
Mississippi	75,448
N. W. Territory	*45,365
Orleans	*76,555
Illinois	55,211
Alabama	127,901
Missouri	66,586
Western Territory	*50,000
Michigan Territory	8896
Arkansas	14,246
Florida	*50,000
District of Columbia	33,039

Thus the entire population in 1820 was nearly 10 millions. In 1810 it was only 7¼ millions. It is now therefore probably about 14 millions, taking the same rate of increase.

One sad blot in this fair picture, our American friends must not wonder if we grieve over. In 1799, of every thousand, 177 were slaves. There has been a gradual but very slow diminution of this lamentable ratio; for in 1820 there still remained 159 slaves in every thousand! Oh! spirit of freedom and benevolence, arouse thy dormant energies, and remove this foul disgrace.

In the United States there are 7530 *post offices*. In 1789, the number was 75. The extent of post roads is 105,336 miles.

The *patents for inventions*, granted between 1790 and 1815, were 2227. From the beginning of 1815 to the end of 1828, there were 3289; of which 1098 were issued to persons residing in the state of *New York*.

The number of *military posts* is 51; of *arsenals*, 10; *Ships of the line*, 7; *Frigates*, 10; *Corvettes*, 2; *Sloops of war*, 14; *Schooners*, 7; *Ships of the line, building*, 5; *Frigates*, 6; *Navy-yards*, 4; *Canals*, 20—their entire length, 2270 miles. *Newspapers*, 802; all published and circulated without stamps, and conveyed through the states at a very low postage.

From a short account of the *religious denominations* in the United States, it appears that the principal persuasions, each of which assembles for worship, and propagates its tenets, unmolested, amounts to about 22. The entire number of churches of these several persuasions is full 19,000; of which 4400 are specified as Baptist churches; Methodists about 1600; Presbyterians, 1946; Congregationalists, 1050: Episcopal church, 9 bishops, 13; clergy, 507. It would seem, then, that though there is no predominant established religion in the United States, religion itself, so far from being neglected, as some have apprehended, receives a greater proportionate share of attention than in any country in Europe. In England and Wales, with a larger population than the American States, we have about 11,000 established churches, and from 5000 to 6000 belonging to the different classes of Dissenters.

But a still more gratifying feature in the picture of America, is that which relates to education. There are 43 colleges, in 33 of which, in 1828, there were 652 graduates, and 2809 under-graduates. The volumes in 30 college-libraries amounted to 128,118; besides which there were in 25 students' libraries 66,730. In addition to these there are 20 theological seminaries, their libraries containing about 40,000 volumes. The Andover, Princeton, and Gettysburg libraries have each 6000 volumes.

Besides these, the number of incorporated academies for the preparation of youth in the genteeler classes for college is very great, and each has a liberal grant of land for its support; and throughout the States, provision is made for the *education of all*, by the establishment of what are called "common schools." These do not succeed equally in all the States; but where they are adequately supported and countenanced by men of local influence, they are productive of the highest benefits.

In *Maine*, by a law of the State, every town, whether large or small, is required to raise annually, for the support of the "common schools," a sum equal at least to *forty cents* (about two shillings), for each person in the town, and "to distribute this sum among the several schools or districts, *in proportion to the number of scholars in each*." In this State, the number of inhabitants between the ages of 4 and 21, is 137,931, of whom 101,825 receive instruction in the common schools. Besides these there are 31 incorporated academies, the actual funds of which are about 200,000 dollars; the number of youth educated at them amounting to about 1500. The population of this State, be it recollected, is under 300,000.

In *New Hampshire*, the sum raised for the common schools is 70,000 dollars annually.

In *Vermont* there are about 20 incorporated academies, where about 800 youth are instructed. The number in the common schools is not specified.

In *Massachusetts* there are 708 academies and private schools; pupils

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19,149. Pupils in the common schools, 71,000; the latter being educated at an annual expense of 164,000 dollars.

In *Rhode Island*, with a population of about 84,000, there are more than 650 schools; that is, about one school to each 60 children that can need instruction.

In *Connecticut*, population 273,000, the number of children in the public schools (in 1828) was 85,000.

But the most extraordinary results with regard to means of education are supplied by the state of *New York*. There are five colleges, besides medical schools of the highest respectability; the number of students in these colleges exceeds 800. The incorporated academies were 36 in 1823; they now amount to 40, and the number of pupils to about 3000. There are also several "Lancaster schools, or schools on the monitorial system." The "common school system" was first brought into efficiency in this State about 1814 or 1815. In 1816 there were 2755 school districts, from 2631 of which returns were received; in these the number of children between 5 and 15 years of age, was 176,449, of whom 140,106 were receiving instruction. Since that time the numbers of school districts and of scholars have greatly increased. The returns for 1829 specify 8609 districts, from 8162 of which reports have been received. The number of children between 5 and 15 years of age was then 449,113, and the number actually receiving instruction in the schools, 468,205: some children being admitted before they were 5 years of age, and a few retained for two or three months after they had attained the age of 15. It seems probable, therefore, that in these schools, *very nearly*, if not all the children between 5 and 15 are under instruction! The average annual expense of the instruction of each scholar, it appears from the returns, is *less than half a dollar!*

What must we in Britain, who boast of our superior intelligence, and of our rich, varied, growing and ample provision, for instruction of every kind, say and feel on reading such a statement as this? Excepting some of the more favoured districts in Scotland, where every body can read, there is nothing, we fear, on this side of the Atlantic, which will bear the least comparison with the efforts and the success of the Americans, especially those of the State of New York, in the diffusion of knowledge. May their example be promptly and energetically followed in this country! And may all the friends of knowledge amongst us—not those only who bestir themselves in the business of education from a love of fame, and whose zeal seldom extends beyond a flaming eulogium after a tavern dinner—but the men who devote themselves to the support and extension of Sunday schools, Lancaster schools,* &c. from motives of genuine benevolence, and from a deep conviction of the benefits moral as well as intellectual, which flow from sound instruction—may they take courage from what has already been accomplished, and determine never to relax their efforts in this noble cause, until our means of communicating knowledge to *every* class, and our success in that diffusion, are commensurate with those which America holds out to our imitation.

From another source of information, Dr. Spafford's "Gazetteer of the State of New York," we learn that Judge Peck, an inhabitant of the town of Burlington, in that State, was the father of this admirable and efficient system. "I cannot now (says Dr. S.) revisit Burlington without mentioning the late Jedidiah Peck, as a man eminently entitled to remembrance by the rising generations of New York. The common school system, now 'in the full tide of successful experiment,' was, most emphatically, *his* work; to which he devoted himself with a truly patriotic, I had almost said, with a prophetic ardour. Judge Peck was a man of humble pretensions to talents, and still more humble learning; but of principles as firm and incorruptible, as ever any man possessed, in any country, or in any age. There was a pure principle of honest patriotism about him, that made him quite obnoxious to certain dictators; and the youth of this Republic should be reminded of the sneers of a class of politicians, anxious to put him out of their way, who vainly strove to fix all sorts of imputations and odium on the character of 'Squire Bushel,' because, forsooth, his name was Peck. Youth of the Republic! he enjoyed a complete triumph, lived to see it, and his memory lives in honour, committed to your safe keeping. He has passed from works to rewards, uninjured by the shafts of calumny and reproach; though wounded and grieved, he never complained, nor ever returned evil for evil."

* We cannot bring ourselves to apply the "*cakish*" phrase, "British and Foreign Schools," to these useful institutions.

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A BYSTANDER, FROM A LOOKER-ON RESPECTING THE POINTS IN DISPUTE BETWEEN MR. GILMAN AND A PRACTICAL ENGINEER.

Sir,—Without entering into the dispute between Mr. Gilman and his opponents, I must be allowed to say that *illiberal* remarks can only tend to weaken the cause of the party having recourse to them, in the estimation of all whose judgment is worth regarding. In this class I must place some of the observations of "A Practical Engineer," in your number of to-day; for I do not remember that it was any where stated that the drawing of the generator was an *exact* one, or to a scale. For my own part I took it for a rough sketch for the purpose of explaining the *principle* proceeded upon, and *nothing more*; and this being the case, we have no right to expect the drawing to exhibit the mode of making the joints, or the size of the bolts. The method of making the joints has been described; and although it *was* stated that the parts were "accurately faced," if it had been even said that the parts were *carefully fitted and ground together* previous to the copper-wire being introduced between them, it would *only* have proved that *the grinding together of the surfaces was labour wasted*; and by *no means* that all Mr. Gilman's statements were "*fudge*," as his opponent asserts. It is *absolutely necessary* that the parts should not *touch* each other, but bear on the *wire only*; and therefore that the faces should deviate *less* than *half a sixtieth of an inch* from *true faces*; and if "A Practical Engineer" will inform us how this is to be attained *without turning*, I shall be obliged to him. The combined sectional area of the bolts has been expressly stated by Mr. Gilman; and are we to assume that statement to be false, because he does not agree with a *sketch* which was *never designed to give the measure of them*? Certainly *not*; nor have we any right to insinuate that Mr. Gilman's statement is false, without having sufficient reason for doing so. As to "A Practical Engineer" knowing what "bolts *will* do," he must be sadly ignorant if he did not, for it is a matter of most simple calculation.

I do not conceive the name of Mr. Horn is quoted "to prove" the joints would not hold. It was asserted by "A Practical Engineer" that they were not tight, and the fact is *acknowledged by Mr. Gilman*: the matter in dispute, therefore, is not *whether they were tight or not*, but the reasons *why* they were not tight; and these are very differently explained by Mr. Gilman and his opponent.

I must observe, that if "A Practical Engineer" really thinks Mr. Gilman's statement false, and *only* wishes to make the *truth* manifest, he will content himself with putting a *fair* construction on that gentleman's statements: most certainly if he does *not* do this, we shall think the "end and aim" of his lucubrations is to make Mr. Gilman *appear* an impostor, *whether he is so or not*, and *we shall appreciate them accordingly*.

I am, Sir,
Yours, &c.
S. Y. (An Engineer.)

April 3, 1830.

GENERAL SOLUTION OF EQUATIONS.

Sir,—In reply to the inquiry of "Novice," vol. xii. p. 298. I beg to observe, that in Wallace's "Elements," Young's "Algebra," and other works which treat of this general method of solving numerical equations, the rules are not sufficiently explicit with regard to the commencement of the operation where the answer rises higher than the unit's figure. It should have been remarked, that the highest figure of the root being determined and placed in the quotient, must also be put under the proper place of the second co-efficient with respect to units, tens, &c., and that the products of the sums arising, must retain the same place under the successive co-efficients or divisors. This will cause the answer to be obtained by single figures, whether in whole numbers or decimals. I hope the following method (see next page) of working the examples given will render the process sufficiently manifest; and to make it as clear as possible, I have marked the *trial divisors* with *tr*.

I am, &c.

Ryde, W. D. SNOOKE,
Jan. 18, 1830. (formerly VECTIS.)

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$x^3 + 9x^2 + 4x = 1940(10$

1

$19 \times 1 = 19$

$194 \times 1 = 194$

0

$x^3 + 0x^2 + 4x = 1040(10$

1

$10 \times 1 = 10$

$104 \times 1 = 104$

0

$x^4 - 9x^3 + 6x^2 - 1x = 1590(10$

1

$1 \times 1 = 1$

$16 \times 1 = 16$

$159 \times 1 = 159$

0

$x^3 + 3x^2 + 3x = 39303(33$

3

$33 \times 3 = 99$

3 $\quad 993 \times 3 = 2979$

$63 \times 3 = 189$ $\quad 9513$

3 $\quad 2883$ *tr.*

93

3

$96 \times 3 = 288$

$3171 \times 3 = 9513$

Perhaps the greatest difficulty for young students is when there are such negative divisors as occasion the *trial* or *real* divisors to come out negative. The following examples will, I trust, afford proper illustrations of the several cases:—

Given $x^3 + 24x^2 + 37x = 46600928$; to find the value of x.

$x^3 + 24x^2 + 37x = 46600928(352$ Ans.

3

$324 \times 3 = 972$

3 $\quad 97237 \times 3 = 291711$

$624 \times 3 = 1872$ $\quad 1742982$

3 $\quad 284437$ *tr.*

924

5

$974 \times 5 = 4870$

5 $\quad 333137 \times 5 = 1665685$

$1024 \times 5 = 5120$ $\quad 772978$

5 $\quad 384337$ *tr.*

1074

2

$1076 \times 2 = 2152$

$386489 \times 2 = 772978$

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Given $x^4+0x^3-12x^2+12x=3$; to find x.

x^4+0x^3 $\quad -12x^2$ $\quad +12x$ $\quad =3$ $\quad$ (·44329 nearly.

4							
4	×4 =	·16					
4		−11·84	×4 =	−4·736			
8	×4 =	·32		7·264	×4 =	2·9056	
4		−11·52	×4 =	−4·608		·0944	
12	×4 =	·48		2·656 *tr.*			
4		−11·04					
1·64	×4 =	656					
4		−10·9744	×4 =	−·438976			
1·68	×4	672		2·217024	×4 =	·088681	
4		−10·9072	×4 =	− ·436288		·005719	
1·72	×4 =	688		1·780736 *tr.*			
4	×	−10·8384					
1·763	×3 =	53					
3		−10·8331	×3 =	− 32499			
1·766	×3 =	53		1·748237	×3 =	·052245	
		−10·8278	×3 =	− 32483		·000474	
				1·715754 *tr.*			
				−22			
				1·7135	×2 =	·000343	
				−22		·000131	
				1·7113 *tr.*			

Here the work is contracted in finding the last two figures, in the manner of division of decimals.

As one root of this equation is found by trial to lie between 2 and 3, such root may be found by the following method. It will be observed, that in this method the first trial divisor is −4 to go in 11, which seems to give no clue towards finding the true quotient figure 8; this is occasioned by a crossing of values, one term of the equation being +, and another −. And here it may be remarked, that, under all circumstances, the *second* figure of the root is determined with more difficulty than any other, because the rectification of the trial divisor will *here* affect its value in the greatest degree.

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$x^4+0x^3 \quad -12x^2 \quad +12x \quad =3 \quad$ (2.858, &c.

2					
2	×2 = 4				
2	8	×2 =	16		
4	×2 = 8		−4×2 =	−8	
2	0	×2 =	0	11	
6	×2 = 12		−4 *tr.*		
2	12				
8·8×8 =	7·04				
·8	19·04×8 =		15·232		
9·6×8 =	7·68		11·232×8 =	8·9856	
·8	26·72×8 =		21·376	2·0144	
10·4×8 =	8·32		32·608 *tr.*		
·8	35·04				
11·2×5 =	·56				
	35 60×5 =		1·780		
			34·388×5 =	1·7194	
				·2950	

W. D. S.

[This method of solution Mr. Snooke justly considers inestimable in what may be termed practical algebra; and he has given some further examples with the figures more closely packed, for which we shall endeavour to find room in a subsequent Number. We have been also favoured with very correct solutions of the 1st, 2nd, and 4th problems from Mr. Russel.—Ed.]

FIRE-INVITING CONSTRUCTION OF HOUSES.

Sir,—As the house which was destroyed by fire at the corner of Wells-street, Oxford-street, has been alluded to by Mr. Baddeley, jun., I could not but reflect, on passing it some time ago, on seeing the wooden brestsummers connected with the timber joists and the wooden story-posts, (which by-and-bye will be covered with thin *match-wood* casings, usually called the shop front, and eminently calculated to hasten the destruction of the more substantial timbers) that there will be some difficulty attending the attempt to prevent the continued use of such inflammable materials. There were, indeed, a few cast-iron pillars, but those, it was evident, were introduced more from convenience than from any idea of giving additional security from fire.

With the recollection of the recent danger from which the inhabitants in the house, occupying the very spot, had but just time to escape, and with the knowledge also that many fatal

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and other dreadful accidents are continually occurring, occasioned by the burning of such constructions, we might reasonably have expected to observe some attempt to lessen the risk in the new building.

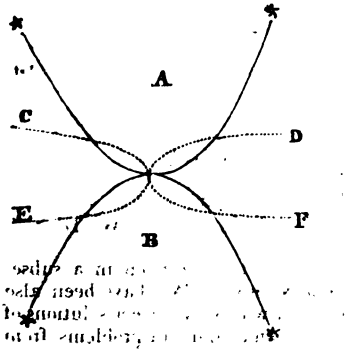
And will it, I would ask, be permitted, that the house at Brompton, (which was recently destroyed by fire, and in which 3 children perished, and their mother was so injured that she is not expected to survive) shall be rebuilt in a manner as combustible as before?

I would also inquire what Mr. Hartley's method was, by which he proposed to secure buildings and ships from fire, and what success attended the grant to him of parliamentary assistance.*

C. D. S.

MECHANICAL GEOMETRY—CUSPS OF CISSOIDS.

Fig. 1.



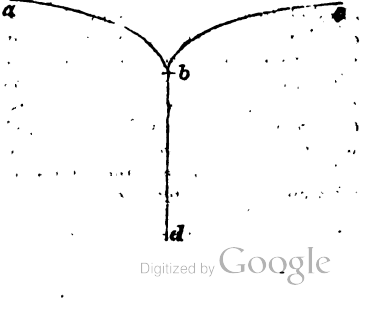
In fig. 1. if the parabola A roll upon the parabola B, which is equal to it, the apex of the parabola A will describe the cuspidated cissoid CD. But if B roll upon A, it will describe the cuspidated cissoid ER. Now, whatever the radius of curvature at the cusp of the cissoid may be, two cissoids being thus united at their cusps, ought, it is presumed, to form fair lines of curvature, either in the direction from C through the cusps to E; or from D through the cusps to F; or from D through the cusps to E; or from C through the cusps to F. That these cusps unite at the same centre, as well as tangent of curvature, no one will perhaps deny; but if such an union be fair, and if the radius of the cusp be infinitely small, then in the lines CF or DE, at the point of contrary flexure, the radius of curvature is infinitely small. Also, at the apex of the lines CE or DF, there would be a point of infinitely small radius of curvature. I apprehend, however, that such would not be the appearance if two cissoids were thus, in the most accurate manner, drawn and united; indeed, if at the cusp the radius of curvature be infinitely small, it would seem to amount to this—that there is no difference between a point of infinitely small, and a point of infinitely large radius of curvature, and that either may be a point of contrary flexure, or occur in an oblate line.

As the apex of either parabola describes the cissoid, the one cissoid may be called the *relative* of the other cissoid. The one is described by a point on A, that comes in contact with the point on B, which draws the other. On this account the points, and also the lines produced by them, are called relatives.

The utility of the term *relative* will be better understood when a few more cases are described.

In the case (see No. 338, p. 406) when the line A, fig. 6, rolls upon the parabola B (marked E), its apex will describe a cuspidated conchoid; but if the parabola B roll upon the line A, its apex will describe a right line. The right line is therefore the *relative* of the cuspidated conchoid, and their union at their cusps is represented by

Fig. 2.



* Mr. Hartley's method consisted in protecting the wood work of buildings and ships by iron-plates. We believe its efficacy was completely established; for we remember reading of a memorable attempt which was vainly made to set fire to a house that protected, in one of the upper stories of which the late king, and some of the younger branches of his family, had stationed themselves, to witness and give eclat to the experiment.—EDIT.

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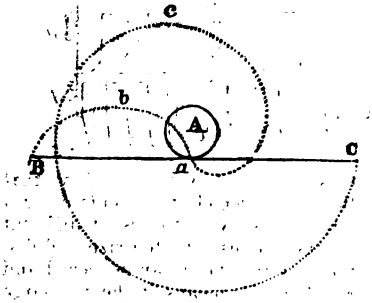
a b, *c* being the cuspoid, and *b c* the right line. And, judging from the mode of generation, this union would also appear to be fair; but in consequence of not being able to draw a line without breadth, it is difficult to join them, at least on a small scale, so as to have the appearance of perfect continuity. The difficulty would be less if drawn on copper.

It may be remarked here, that the contrary or *reverse* motion of Mr. Child's parabolic trammel does not produce similar lines, as Mr. C. has stated: the elements of the opposite planes being dissimilar, as may be seen by the diagram in the former paper, just referred to. But a parabolic trammel, constructed on the principle of the cissoidal motion, fig. 7, p. 406, vol. xii., would be similar on both planes. But in this way there is reason to suppose it would be more difficult to make the apparatus describe with accuracy the vertex of the parabola, or pass without a shake from one branch to the other.

If the wheel A (fig. 3) rolls along

Fig. 3.



the right line CB, the cuspidated cycloid *a b* B is described; but if the right line CB roll around the wheel A, the cuspidated line *a c* C, a part of one branch will be drawn, which is the *relative* of the cycloid. Here again the union would appear to be fair, and an inflected line is produced; but, if the cycloid had been united to the other branch, or an evolute described by rolling the right line the other way around the wheel A, the line would not then have had any point of contrary flexure—the union would have been oblate.

If the radius of curvature of the evolute at the cusp be *o*, which it must be to form a fair union with the cusp of the cycloid, if it be infinitely small, it would, I think, appear doubtful, whether another point at the distance of the radius of the circle from the right line, which "Pascal" said would describe the spiral of "Archimedes," would draw a line, commencing, or rather having the point of union of the two branches of infinitely small radius of curvature.

I am, &c.

JOSEPH JOPLING.

(To be continued.)

PUBLIC SEWERS.

The "Boston Mechanicks' Magazine" (another namesake which has just made its appearance in the western hemisphere, and gives every promise of doing honour to its parentage,*) quotes the account which we gave in our 319th Number, of the excellent improvement in public sewers, lately brought under the notice of the London public by Mr. Cuff, accompanied by the following remark:—"Before our Boston readers finish perusing the article, they will anticipate us in announcing the fact, that *this very improvement* has been used in Boston for public purposes for many years, and in the yards, &c. of our dwelling-houses, twenty-five or thirty years." In proof of this there is afterwards given an engraved section of part of a Boston street sewer, which we freely acknowledge, establishes past all doubt, the fact of our Trans-atlantic brethren having had the start of us in this particular instance.

Our brother editor hints that it is somewhat surprising the citizens of Boston should in this, as in some other instances, be in advance of the citizens

* There is a peculiarity in the orthography of our Boston relation, which we must absolutely except from this our paternal approbation. "Mechanicks," "publick," "characteristick," "topick," "Atlantick." Was there ever any thing so barbarous? We cannot do better than quote, for the edification of our brother Editor, the remarks of his own countryman, Dr. Webster, in the preface to his admirable edition of Dr. Johnson's Dictionary—the best edition certainly which has ever yet appeared, and which we are glad to observe is now republishing in this country, under the able superintendance of Mr. Barker, of Thetford. "In excluding the *k* and *ck*," says Dr. Webster, "from such words as honour and music, I have followed *the decided tendency of the public mind, both in this country and in England.*"

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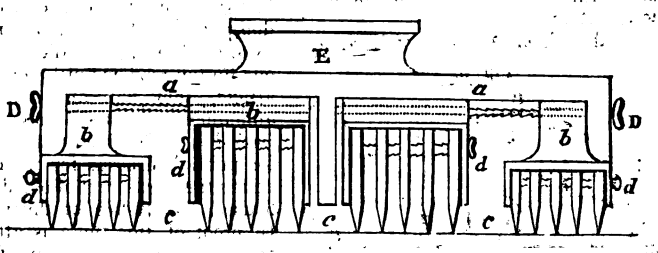
of a city so much older, as London, in the march of improvement. But how much greater will his surprise be, when he learns that this mode of construction so long ago adopted in Boston, and the utility of which is so obvious that one would suppose it had only to be pointed out to be followed every where, has, since we wrote our account of it, been deliberately rejected by the corporation of our ancient, but sadly governed, metropolis! The person who introduced this improvement in Boston, appears to have been a Mr. Ephraim Marsh, a superintendent of streets, who, in a report to the mayor and aldermen of that city, dated June 1823, proposed a series of regulations for the building of sewers, the third of which is in these terms—"There should be a cesspool built at the angles and crossings of other streets of stone, four feet by two in the clear, to be sunk two feet *below the common sewer*; to be raised and capped with curb-stone (grooved to receive a three-inch oak plank) even with the paving: the plank to be taken up twice a year, and the cesspool cleared of what might fall from the drain." This, it will be observed, is precisely Mr. Cuff's plan; and that which we must still hope—in spite of the opposing interests of corrupt corporation jobbers, to see adopted in London, as well as Boston. An advantage is mentioned by our Boston contemporary, as attending this mode of constructing sewers, which we omitted to include in our list of recommendations; it is this, that where there are these cesspools, the passage of rats from one division of sewers to another, is entirely prevented, and the numbers as well as range of these destructive vermin greatly diminished.

MUSIC RULER.



Sir,—The above drawing represents the exact dimensions of an instrument I have invented, for the purpose of ruling music-lines with expedition and ease. It is the section of one calculated to rule four staves at once; *aa* is the exterior frame, inclosing four smaller ones, *b*; each of these contains five small steel points, *c*, furnished with slits at the end for retaining the ink, and producing the lines. These slits are omitted in the drawing. By means of the small screws, *d*, these points may be moved to any part within the lesser frames *b*, close to or at different distances from each other, and thus produces lines with less or greater spaces. The two large screws DD, the ends of which are fixed in the frame *a*, pass through the top of the four smaller frames, and by moving them in the same way as the others, these frames may be placed so that the points which they contain shall form staves, with spaces of different widths. Thus both the size and distance of the staves can be varied and regulated by means of the two large screws D D, and the four lesser ones *d*, *d*, *d*, *d*. It will be seen that the greater the number of small frames contained in the instrument, the larger will be the quantity of music-lines ruled at one stroke, and the greater the expedition. The instrument must be guided by a straight ruler, and held by the handle E, in the same direction as a common pen.

I would recommend it earnestly to such as stand in frequent want of music-paper, as a very convenient little pocket instrument.

I remain, &c. W. H. B.

Beaminster, Feb. 16, 1830.

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Pedomotive Carriages.—Sir, If a correspondent, signed "Benevolo," vol. xiii. p. 31, of the "Mechanics' Magazine," on the subject of pedomotive-carriages, will leave his name and address at Mr. Holloway's Library, Dean-street, Westminster, he may probably obtain what he desires from

Yours, &c.

J. A.

March 17, 1830.

Statistical Puzzle.—There is a country where the land is always ploughed, but seed never sown, and which yet yields abundant crops year after year, without intermission. Where is this country, and of what kind are the crops? *Note;* that there is nothing figurative in the words here used, which are all to be understood literally.

FELICIA.

HISTORICAL NOTICES OF INVENTIONS AND DISCOVERIES.

Watt's Steam-Engine Indicator.—"Many years ago, Mr. Watt invented and applied a small instrument, which he called an Indicator, to his steam-engine; it indicates what extent of plenum and vacuum is alternately formed within the cylinder in order to impel the piston when the engine is at work. It is of very important use in giving engine-makers true knowledge how to make good engines; and it was of very great use to the inventor, just as a hydrometer to a distiller. He kept it a profound secret for many years; and in 1814, when he published an account of his other inventions, he gave only an imperfect description of a part of this one, without any hint of parts which are essential to the successful use. A complete instrument afterwards fell into my hands in Russia, where it had been made by some of the people sent out from this country with Mr. Watt's steam-engines. At my return to England I made one, and also showed several other engineers how to make such for themselves; and since that time, every one of these persons has very greatly improved his practice, by the light it has enabled him to throw upon an obscure part of the operation of steam in an engine."—*Mr. Farey's Evidence before the Committee on the Patent-Laws.*

Watt's Machine for making Sculptures.—"Mr. Watt invented and made a machine for executing sculptures, which he never disclosed; he showed me many specimens of the performance in ivory and alabaster in 1814, and made me a present of one carved by his machine, which proved that it must have arrived at considerable perfection; he died in 1819, and, I believe, never disclosed that invention any farther than as the machine may have explained itself. He was striving to make it carve marble and hard materials, and he showed me some first trials in stone, but they were not perfect, and he did not live to complete a large machine adequate for executing real sculptures in marble."—*Ibid.*

Burning-Glasses.—Aristophanes, in his comedy of "The Clouds," introduces Socrates as examining Stripsiades on the method which he discovered to get rid of his debts. "I'll use my glass," says the latter, "that I light my fire with, and if they bring a writ for me, I'll place my glass in the sun at a short distance from it, and set it on fire." A proof that even long before the time of Archimedes, the ancients were familiar with the igniting power of crystal lenses.

Smelting Iron-Ore with pit-coal instead of wood, which has proved of such incalculable advantage to the arts of this country, was first introduced in the reign of James I. by a Lord Dudley, who obtained from the Crown a patent for the process, which is included among the exceptions to the operation of the famous Statute of Monopolies passed in the reign of that monarch. The invention, however, was not successfully practised till more than a century afterwards; and the original patentee, Lord Dudley, ruined himself by his attempts to bring it to bear.

The German Silver, which is now coming into vogue, has been introduced, as its name denotes, by the Germans into Europe, but is nothing more than the white copper long known in China. The Goldsmiths' Company of London have thought it proper to warn the public by advertisements in all the newspapers that it does not contain a single particle of real silver. This is true, for it is only an alloy of copper, nickel, and zinc; but it would have done no discredit to their candour to add, that it is, on account of its perfect unalterability, superior for many purposes (such as musical instruments, touch-holes of guns, &c.) to either silver or gold. Although only now coming into *known* use in England, it has been no stranger to the manufactories of Birmingham for at least thirty years and more. —Z.

Steam-Navigation.—In March, 1786, the Legislature of New York granted to a person of the name of Fitch, and his descendants, the exclusive right of "making, and employing, and navigating, all kinds of boats or water-craft, which might be impelled through the water by force of fire or steam, in all the creeks, rivers, and bays, and waters, whatsoever, within that State for 14 years." Fitch never availing himself of this privilege, the New York Legislature, in 1798, repealed that Act, and granted the same privilege to Robert L. Livingston, under certain restrictions as to the time when he should accomplish his object. Nothing material, however, was effected until April, 1803, when Robert Fulton joined with him. By successive Acts, the exclusive privilege was secured to these gentlemen for thirty years; and between April and July, 1808, they gave the required evidence, "that they had constructed a steam-boat of more than twenty tons, propelled by steam, more than four miles an hour against the stream of the Hudson between New York and Albany." Thus were twenty-two years expended in bringing to perfection this noblest of human inventions.—*Boston Mechanicks' Magazine.*

(To be continued.)

INTERIM NOTICES.

We like very much J. B., Jun.'s design, but should be glad to have some more specimens before commencing.

The letter to A. P. E. R. was sent by post. His last, however, renders the miscarriage of no consequence, beyond the delay that has been thus necessarily occasioned.

Mr. Hudson's reply to Mr. Baddeley came quite too late; it shall appear next week.

Communications received from J. P.—T. T.—Detector—Americanus—An Operative—Iais—Mr. Miller.

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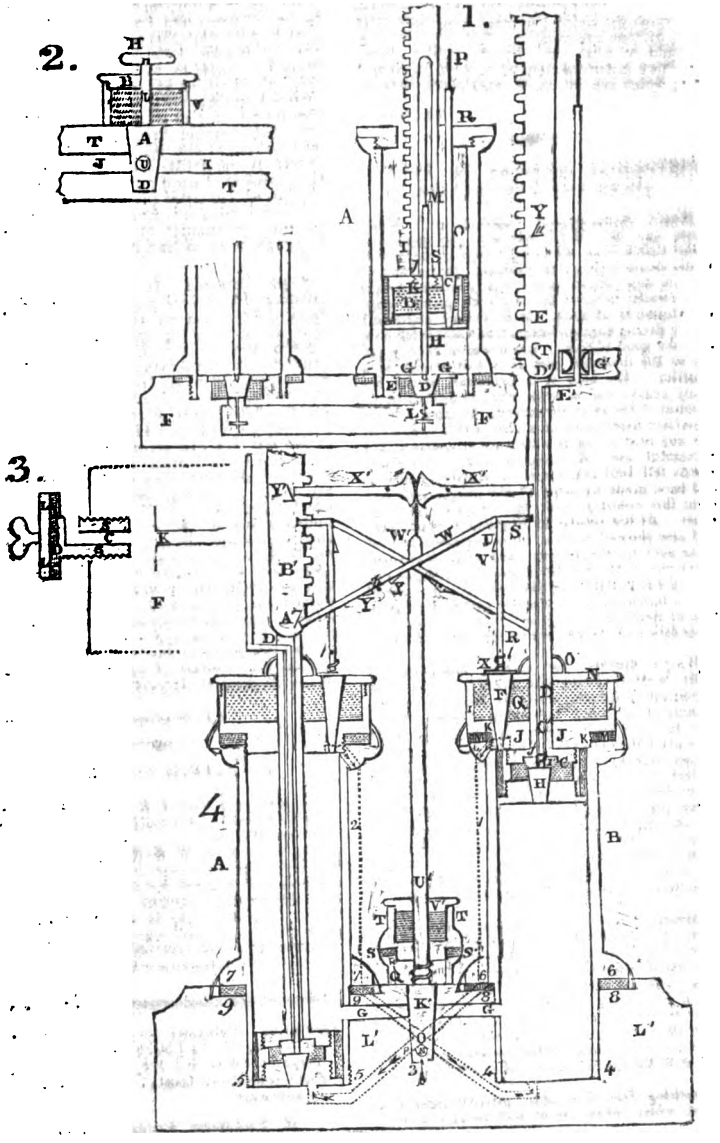
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE

No. 349.] SATURDAY, APRIL 17, 1830. [Price 3d.

IMPROVEMENTS IN AIR-PUMPS.



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IMPROVEMENTS IN AIR-PUMPS.

Sir,—It has long been a desideratum in pneumatics to acquire a more perfect air-pump than that in common use. The chief objects remaining to be attained, are an abridgment of the time and labour required for working the pump, and such an arrangement of the parts that the valves shall act independently of the spring of the air—shall allow it a free passage, and at the same time produce as perfect a vacuum, or rarefaction of the air, as it is possible to derive from mechanical means.

Constructed with a view to the above objects, I shall now lay before your readers two original plans. In the *first* plan the valves are made to open mechanically, and thus I believe a better rarefaction of the air may be produced than with bladder valves; a parallel motion may also be attached; to move the pistons, which motion will, I believe, save labour. In the *second*, the valves act as above, and a similar motion may also be attached; but what I esteem as the most novel and useful property of it is, that each barrel is made to act in the process of exhausting, with an effect equal to the two pumps of the common double pump, and that by a very simple contrivance.

Observing in No. 155, page 233, a plan for an air-pump without valves, I procured one like it, with these additions, viz. a valve on the top plate of the barrel, and a small pipe at the side near the bottom, so that the air beneath the piston when it approached the pipe communicating with the receiver might escape above, and allow it to strike the bottom. The barrel was 10 inches long, 1¾ interior diameter, and the piston moved up and down with a simple handle on the piston rod. This mode of operating, however, proved both tedious and laborious. I found also upon making the downward stroke, that the air was driven back with considerable force into the receiver—this was inconvenient. But this last objection, I in a measure obviated, by placing a valve in the piston, which then excluded the use of the small pipe abovementioned.

The barrel of this pump being imperfect, and the motion so laborious, I was induced to lay it aside till I could contrive an easier motion, which I believe I have at length accomplished, having now by me several methods by which I can obtain a circular motion, and the plans for valves before spoken of. The plans for this motion I showed to a friend, who, a few days after, brought me vol. ix. "Mechanics' Magazine," and therein, to my great surprise, showed me, in No. 244, a plan for such a motion; which plan, till then, I was totally ignorant of. Thus was snatched from me the pleasure of communicating to your work what I conceived to be a novelty, and a useful alteration on the method in use at present. As my plans, excepting one (which acts with only one toothed wheel), are similar to the one just spoken of, I think it useless to notice them here. I also noticed in the same volume Mr. Evans's plan, which is certainly an improvement on plan, No. 155, vol. vi., page 233; but I hope to show, that with a few alterations, a barrel of that form may be made capable of exhausting twice as rapidly and with less labour.

I shall now lay my plans before you as they occurred to me, and describe them as minutely as possible, that any error may be the more easily detected, and thus a wider field opened for improvement in this useful instrument.

First Plan.

Fig. 1. Let A be the barrel (only one being here necessary to be described) B the piston, C the valve, or as it may more properly, perhaps, be here called the metal plug; D, bottom of the barrel; E, represents a set of oiled leathers put into a cavity turned in the brass stand FF, in which stand the barrels are screwed. These leathers are confined by a circular plate of brass, G, ⅛ inch thick, which also answers the purpose of giving the barrel a firmer bottom than the leather only, for the piston to strike against; H is a perfectly cylindrical metal rod, moving in a collar of leather in the piston; this rod is rather longer than the barrel and moves in the rack I, so that there is sufficient space for the air to pass between it

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and the interior of the rack, and to escape at either of the apertures JJ. The leathers in the piston are to prevent the air from insinuating itself into the barrel beneath the piston, which would be the case, if the rod H did not move air-tight in them; above the leathers is a spring placed as at K, the friction of which, and the leathers, as the piston moves upwards, lifts up the plug D to a height necessary to allow the escape of the air from the receiver between the plug and its collar of leathers. This height is determined by the cross-wire L beneath D, and to which it is attached. The wire L, as may be seen by inspection, is longer than the diameter of the aperture in which the plug moves. As the piston continues to move upwards, the friction above noticed overcoming the friction of the plug with its leathers, and every other friction, holds the plug up, but as soon as the piston-spring and leathers arrive at the thin part M of the rod H, they no longer exert any pressure; and thus the plug by its own weight, that of the atmosphere on its rod, and the force of the metal spring N placed to act on the cross-wire L, is forced air-tight into its proper place. C is the piston-plug moving air-tight in the same leathers in which the rod H moves—which leathers are in all these plans shown by the dotted lines; O is the rod, of which the part P is slender; RR are metal springs fixed on the brass plate which closes the top of the barrel for the piston to strike against. It will be seen that when the piston is taking its downward stroke, the friction of the springs RR upon the plug-rod O, holds the plug up; and as the piston is moving down, the plug would be left behind were it not prevented by the stop S, placed a certain height above the upper surface of the piston, which thus allows the springs RR to keep the plug open; and gradually as the piston moves, the rod O is drawn through the springs till it arrives at the thin part P, when the springs ceasing to act, the plug becomes air-tight in its proper place.

Some pumps have attached to them a stop-cock, to cut off all communication with the receiver and barrels after the former has been exhausted. The common stop-cock appears to me to offer too many places where the air may force a passage, when it is attached to any part of the apparatus which it is required to exhaust; perhaps the following method may be more secure. Fig. 2. TT represents the pipe-piece; JI, the aperture; A, the plug; U, the aperture in the same; V, a collar of leather, box with oiled leathers in it; L, a well-turned rod, to which the handle H is attached, and which screws and unscrews, so that the leathers may be placed firmly round the rod L, and the cap B screwed on. Thus, this part is rendered air-tight; and the plug moving air-tight in TT, and the bottom part D having no communication with the atmosphere, is perfectly secure. The cap B admits of being screwed round so as to confine the leathers tight on the plug, thereby pressing it down and rendering it more secure.

The screw-piece, to let the air into the receiver, as attached to the common pump, from being obliged to be taken out of the aperture in which it is screwed is very inconvenient. I propose the following:—Fig. 3. SS represent the screw; CC, a small aperture, which is brought to communicate with the external air, when the air enters at C, rushes towards C, and then to K, leading to the receiver: there is a shoulder, LL, on the screw, beneath which is placed a piece of oiled leather DD, and this renders the screw air-tight when it is screwed against the plate F.

Second Plan.

Fig. 4 represents a pump in which each barrel, separately taken, performs the work of the common double-barreled pump. Let A and B be two barrels, the same in form as that first spoken of; C, the piston; D, the rod moving in a collar of leathers, and communicating to the rack-work E; F, a metal plug in the leathers at the top of the barrel; GG, the aperture leading from barrel to barrel, and to the pipe communicating with the receiver-plates; H, a metal plug in the piston; II, a brass box in which the leathers are placed, and

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through which the rod D moves—which box is cast with, or is brazed on the place JJ, which closes the top of the barrel, screwing into it, as shown by the screws KK. LL is a ring or projecting rim on the barrel; on this a piece of well-oiled leather, MM, is placed, on which the plate JJ screws down, and pressing upon the leather renders this part of the barrel secure from the admission of air. There is a cap, or lid, N, which screws on the box II, to confine the leathers it contains; O, represents a small vessel fixed on the cap N to contain oil, through which the rod D moves, and is thus kept oiled, as are also the leathers; PP is an oil-vessel to render the leather MM likewise more secure.

Having only briefly pointed out the principal parts, I shall now proceed more minutely—beginning with the plug F, at the top of the barrel: this plug moves air-tight in the leathers Q; R is a metal rod connected with the plug; S is a small projecting arm, which, when the catch T on the rack E approaches it is lifted to a certain height, is then dropt, and caught on a pin V by the small catch U, projecting from the rod R. The rod and its catch are disengaged from the pin V by the obliquely placed bar W; this bar is moved, when required, by a circular projection A′ on the rack B′ of the barrel A. It will easily be seen that when this projection approaches the bar, that it forces it into contact with the rod R, which rod is then thrown off from the pin V; consequently the plug F, being no longer held up, drops, and is forced air-tight into the leathers by the atmospheric pressure, and that of the metal spring X. The bar W is placed obliquely, that it may fall back into the situation it was in previous to the projecting piece A′ acting on it, and it is prevented from moving too far backwards or forwards by the stops YY against the pin Z. The mechanical action of this plug F is so timed, that directly the piston C strikes the top of the barrel the plug drops. The rod R may be made flexible by having a joint moving on a pin as at I. H is the piston-plug, moving in a collar of leathers in the piston; it is connected to the small rod C′ moving in the rod D, sufficient space being allowed for the air when the plug is open to escape past the thin rod C′ to the aperture D′ (see the barrel A, whose piston is down), above the collar of leather box on the top of the barrel, which is the only communication the plug H is allowed to have with the atmosphere: it has none, as may be seen by inspection, with that part of the barrel above the piston when it is down. The small rod C′ being in the centre of D, there is a small arm E′ bent at right angles, as shown; to this is attached the rod F′, proceeding upwards to the spring-tube G′ (here also see the barrel A, that of B being up to the tube); this rod is of a certain required length according to the space the piston moves in. The spring presses against F′ connected with C′, when it is drawn downward in a similar manner to the piston-plug, fig. 1, and the plug opens; and the air compressed beneath the piston escapes past the plug, through the aperture in which is C′, in the direction of the arrows, till it escapes at the aperture D′. The rod F′ moves on, till the thin part H′ arrives at the spring, which then no longer exerting any friction on F′, the plug H is closed as before-mentioned. I′ is a spiral spring to assist in shutting the plug It may easily be perceived that this plug can only be lifted a certain height, viz. to J′J′ in the piston; and it will also be readily comprehended that when the piston is moving upwards, the rod F′ will gradually slide back through the spring-tube without affecting the plug H, only as it tends to keep it closer.

I now proceed to speak of the small piece of apparatus by means of which the two barrels may be made capable of exhausting, in the same time, as much air out of the receiver, as what four barrels on the common construction can do. In the aperture GG, which communicates with the barrels and the receiver, is placed a plug K′, moving air-tight in the brass L′L′, in which the barrels screw. The dotted circle N′ represents the aperture of the pipe leading to the receiver-plates; it lays horizontally beneath GG, but at right angles with it: the horizontal dotted lines O′, represent

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a small aperture through the plug; the perpendicular dotted lines P′, show an aperture in the plug communicating with O′ and N′. It will be observed that when the plug is down, as shown, all communication between the aperture O′ and GG is cut off, and the same between N′ and GG; and thus this plug answers every purpose of a stop-cock. When the plug is lifted up (by means presently to be described), the aperture O′ is brought horizontal with that of GG, and thus a communication is formed between the barrels and receiver, the air rushing out of the aperture N′ up to P′, in the direction of the arrow 3, through O′, and thence to the barrels. Q Q′ represents a metal box brazed on the brass L′L′, it has a rim or shoulder R′R′, on this is laid a piece of oiled leather S′S′; T′T′ is another box with a corresponding shoulder; this has a screw, which fits into the shoulder RR, and thus is the leather pressed tight, and the admission of air above K′ prevented. In T′T′ a set of oiled leathers are placed, which are confined by the screw-cap V′, through which leathers moves a perfectly cylindrical rod U′, which is connected to K′, and then proceeds upwards. At W′ it is connected to a small chain, to which two similar chains are connected, and which proceed to the levers X′X′. These levers move on a pivot, and are nicely balanced; they proceed to the racks B and E′, on which racks are small catches, which, when required, press upon the levers, and lift the plug K to the height required. It will be seen by inspecting the engravings, that these catches Y′Y′ will not affect the action of the plug when the rack B′ of the barrel A is moving upwards, because of the chains then yielding to the motion of the levers.

Now *of the action of this pump*:—It will be evident that before the piston in A has fairly struck the bottom of the barrel, the catch Y′, on the rack B′ of A.'s barrel, must have acted upon the lever X′ and lifted up the plug K′, which is closed directly the catch Y′ leaves its hold of the lever X′, by a strong spiral-spring placed to act on the plug K′ in the box Q′Q′. The operation is so timed, that this is done the moment the piston of A strikes the bottom, and that of B the top of their respective barrels; and thus the air has been let from the receiver into the barrel A above its piston, and into B below it. The plug K′ being closed by its mechanical action, and each barrel containing air, the moment the pump is put in motion, A.'s piston moves up and the air above it is driven out of the plug, which is placed at the top of the barrel, and which is opened by the means before described, while B.'s piston moves down, and the air beneath not being driven back into the receiver—the plug preventing it—escapes through the opened piston-plug. The moment B.'s piston strikes the bottom of its barrel that of A strikes its top, and the plug K′ being again opened by the catch of the rack of B's barrel, and again closed, the air from the receiver is let into each barrel; but in a reverse manner, being now let in above the piston of B.'s barrel, and below that of A.'s. The motion of the pump being continued, B.'s piston now forces the air out of the plug F at the top of the barrel, while that of A forces it through its piston plug: and thus are the pistons not allowed to make any useless strokes, the air is exhausted as well by the downward stroke as the upper, and a great saving of time and labour is accomplished. The plugs may be made to move air-tight in solid metal.

Since writing the above, it struck me, that I might simplify the pump by disposing of the two top-plugs. The following is the plan by which I propose to accomplish this. Let there be a small metal tube, fig. 4, placed close to the barrel, reaching from shoulder to shoulder, as shown, and perfectly air-tight; let there be an aperture formed as shown by the direction of the dotted lines in the top-shoulder LL of each barrel; let this aperture have a connexion with the interior of the barrel, the plug be removed, and the space it occupied rendered air-tight. Let there be also an aperture in the bottom-shoulder of each barrel, and let this aperture be continued in the brass L′L′; the aperture proceeding from the tube 1 to form a connexion with the bottom of the barrel A, and the aperture proceeding from the tube 2, attached to barrel A, to form a connexion with

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the bottom of the barrel B. The apertures marked with the arrows must be kept distinct from each other; as well that which leads to the barrel, as that which leads to the receiver.

The manner in which they are here placed is not perhaps the best that could be desired, but it is sufficient to explain their use. It will be seen that when one piston is up, the air above it will, instead of having been allowed to escape at the plug on the top of the barrel (which plug is put away), escape down the small tube 1, enter the opposite barrel A beneath its piston, and escape through its opened piston-plug; as the piston moves down, B.'s piston moving up.

I have mentioned that the two barrels screw into the brass L′ L′: 4, 4, and 5, 5, are the screws on the barrel, the barrel entering the brass as far as is shown; 6, 6, 7, 7, are the shoulders of the barrels, beneath which, sunk in the brass, are the leathers 8, 8, 9, 9; on these (which are well oiled) the shoulders screw down tight. The dotted curved lines represent a small vessel sunk in the plate and encompassing the shoulders, setting close to them at the top, the shoulders being partly straight, to admit of their entering the vessels tight; and in these vessels oil is placed, to render the shoulder joints secure from the admission of air.

If any of your correspondents perceive any errors in these plans, I hope they will point them out with candour. I am far from inferring that they are perfect, not having yet proved them sufficiently; and it is not the province of youth, whatever may be its temerity, to pretend to infallibility.

I am, Sir,
Yours, &c.
S. K.

A SONNET.—NO. I.

Happy the land! where knowledge strikes its root,
In a free soil, and spreads its branches wide,
Well laden with bright store of varied fruit,
Inviting man to eat, and be supplied
With truths, which teach him better how to bear
The good that fills his swelling heart with pride;
Or those rough blasts which seem at once to tear
His dearest blessings from his own fire-side!
Curst is the land! whose rulers crush the growth
Of those rich seeds, a Heav'n-implanted good,
To feed the longing land with feast of Truth;
Vainly they hold the multitude a brood
Of grovelling swine—there comes a certain hour,
Shall prove them false, and blast their ruthless power.

A. C.

WEBSTER'S ENGLISH DICTIONARY.

Sir,—I have this moment read with much pleasure your judicious commendation of *Dr. Webster's English Dictionary*, and beg to add for the information of your scientific readers, that in this unrivalled work all technical terms are explained in so satisfactory and complete a manner, as to constitute an *encyclopædia in miniature*; and that while the learned author's definitions are full, precise, and correct, furnishing just so much illustration as is necessary to comprehend the word under discussion, he has most wisely rejected that prodigality of quotation, which increases the price and cumbrousness of Todd's Johnson, without a proportionate increase in the utility of the work.

My principal object, however, in addressing you on this subject, is to point out an error in your statement, which I shall be glad to see corrected in your next publication. Dr. Webster's book is not a mere improved edition of Johnson, as your words would imply, *but an entirely original work*, the labour of a long life assiduously devoted to the science of philology, and is beyond all doubt one of the most important productions of the present century.

I cannot omit this opportunity of offering my warmest thanks to the erudite and enterprising Mr. Barker, to whom all literary persons are already under so many and great obligations, for the republication of this valuable work in so beautiful a style, and at so moderate a price, as to render it ac-

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cessible to every scholar in the kingdom.

Sincerely wishing him all the success his great talents, extensive attainments, and generous ardour in the cause of literature so justly entitle him to, I beg to subscribe myself,

YOUR CONSTANT READER,
and a Subscriber to
Dr. Webster's "English Dictionary."

25, *Percy-street*,
Saturday, *April* 10, 1830.

REPLY BY MR. GILMAN TO MR. SYNGLEMAN.

"I have been induced to take the trouble of transcribing the above, on the *old English principle that every looker-on has a right to see fair play*; and the *circumstance* of the *date* would give to Mr. Hall the merit of *first* using decomposed atmospheric air (or nitrogen), along with high-pressure steam."—Vide Syngleman, p. 442, number 340.

Mr. Editor,—Conceiving that I had proved my case to the extent necessary for my justification, it was my intention not to notice any farther attack, but I am obliged again to take up my pen, as I cannot refrain from expressing the sense I entertain of the obligation I am under to Mr. Syngleman for his *continued kindness* in aiding my cause.

The "Practical Engineer," be it remembered, called my plans by all sorts of pretty names, such as "absurdities," "impossibilities," and the like; but it appears from the extracts with which Mr. Syngleman has favoured us in your 346th number, that Mr. Hall patented on the 31st of May, "1828," very nearly the same thing which the described generator built in "1826" was designed to effect. It is gratifying to find that others have been *guilty* as well as I have been of the *absurdity* of effecting combustion under pressure; while at the same time the dates of Mr. Hall's patent explains quite satisfactorily why no extracts were made before from it.

Now I have my pen in hand I will address a few *more* words to Mr. Syngleman, before I finally take leave of him. It will be seen that in the commencement of his last letter, he scarcely deigns to notice my refutation in the 342d Number, of the assertions he made in his former communication, but passes over in silence the misstatement of which he there stands *convicted*, though the whole question *now* turns upon this point. This is quite in character with the *partial* extracts he furnished on the occasion, when he was *moved* in *spirit* by the "old English principle to see *fair play*."

Finding himself completely at fault as regards the patent of "1824," he at once, without scruple, shifts his ground to the patent of "1828." Of this patent he has the boldness to say, that "in fact it seems only to be a more explanatory statement of the patentee's object:" whereas, the real fact is, that there does not exist the least shadow of a pretence in the patent of "1824," that Mr. Hall contemplated any such object as using the nitrogen of the atmosphere with high-pressure steam.

I shall not touch Mr. Syngleman's jargon relative to the capacity of fluids for heat, nor whether oxygen has greater affinity for the "earthy or metallic parts of the fuel" (as he asserts), than it has for the hydrogen and carbon: though, were I disposed, I could say *something* to him upon these matters; but as I have neither time nor inclination for controversy beyond what I am compelled in my own defence, I shall decline doing so, and leave to him the full *benefit* of his observations.

In conclusion, I beg to assure Mr. Syngleman, that I *do* most "fully appreciate his labour and trouble," and the *motive too* that induced *him* to "intrude upon the public" with so much *modesty*, his *partial* extracts, and the misstatement that he has been *guilty* of in his first communication. And though I have only defended myself against *those* who "run a-muck and tilt with all *they* meet;" yet I am, nevertheless, grateful to Mr. Syngleman for his advice, who, having run his own head against a post, very kindly turns round in the extremity of his pain, and counsels *me* to be more discreet—meaning of course than he has been.

I am, Sir,
Yours respectfully,
London, WM. GILMAN.
March 29, 1830.

[The "Practical Engineer's" remarks on the conclusion of Mr. Gilman's Refutation, shall be given in our next.]

THE NAUTICAL ALMANAC.

Sir,—I am a seaman, and having from very early youth spent my life almost constantly on board, my scientific knowledge is confined to the practical operations usually taught for finding a ship's place, called lunars. A short time ago, being among the Ame-

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ricans, I heard it confidently asserted, that they had discovered several errors in the "Nautical Almanac," published in this country. I own I felt rather uneasy at the reflection that the ship, lives, and property on board, which depend on the accuracy of operations drawn chiefly from this book, might run additional risk from such a cause; but did not know any one who could inform me whether these assertions are or are not founded in fact.

A friend of mine, who is a subscriber to the "Mechanics' Magazine," told me that if I would write to the editor, he would probably either furnish me with the desired information, or give the name of some publication in which the errors alluded to (if errors they be), are noticed. I have now accordingly taken the liberty to address you on the subject, and hoping for a word in reply in your next,

I am, Sir,
Yours, &c.
R. V.

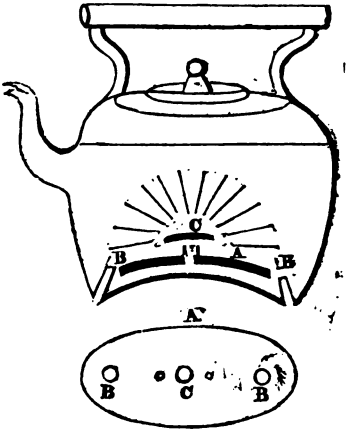
[The errors of our "Nautical Almanac" are unfortunately become but too notorious; it is some consolation however to know that it was not left to the learned of America, or any other country, to detect them. They have been regularly pointed out year after year by our own astronomers, Baily and South, either in communications to the public journals, or in separate pamphlets. And it was but the other day, they were thus summed up in a smart letter in *The Times*, from which we have made an extract respecting the planet Pallas in another part of this week's number. "Planets discovered thirty years ago are still not mentioned in it; occultations of stars by the moon are still declared visible which are invisible; whilst others which are visible are still unnoticed, (a tolerable specimen of which was exhibited on Sunday, the 28th of March last, when we were told of two visible occultations which were invisible, but were not informed of eleven which were visible.) Satellites are still considered as visible and invisible at one and at the same time; occultations of planets are announced as 'near appulses;' the Moon skips over the constellation Gemini eleven months out of the twelve; the Sun's right ascension is still erroneous in every instance; the planetary ephemerides, as well as the planetary distances from the Moon, although so infinitely conducive to the safety of our ships and seamen, are still obstinately withheld; whilst the Moon's distances from the Sun are, as may be seen by reference to the 'American Almanac' for 1830, erroneous throughout the year." The American corrections which our correspondent heard talked of on the other side of the Atlantic, are doubtless those alluded to in the conclusion of the preceding extract, and also noticed in our review of the "American Almanac," in our last week's number.—Ed. M. M.]

STEAM TEA-KETTLE.

Sir,—Having found that in all cases steam forcibly introduced into the lower parts of a vessel of water, would heat the water in it quicker than a strong fire, applied externally to the vessel itself, I beg to send you a description of a boiler or kettle of simple construction, which boils in about half the time that otherwise would be required.

I am, Sir,
Yours, very obediently,
W. H. B.

Wellesbourne, March 8, 1830.



A, a second concave metal bottom to the boiler. BB, apertures for the admission of the cold water. C, vent for the heated steam. O, size of the steam vent for a common-sized kettle.

ELECTRO-MAGNETIC TELEGRAPH, OR INSTANTANEOUS COMMUNICATOR BETWEEN DISTANT PLACES.

M. Ampere, who has acquired so much distinction by his electro-magnetic researches, proposes to establish, by means of voltaic currents a system of telegraphic communication between distant places, which, if found to answer in practice, will be of unrivalled celerity, and of equal efficacy in all weathers. The idea of applying the electric fluid to this purpose is not new, but its revival by an individual of such high authority in this department of science, as M. Ampere, is likely to obtain for it a degree of consideration greater than it has ever before, perhaps, received. The plan of M. Ampere, as described by Mr. Ritchie at one of the late even-

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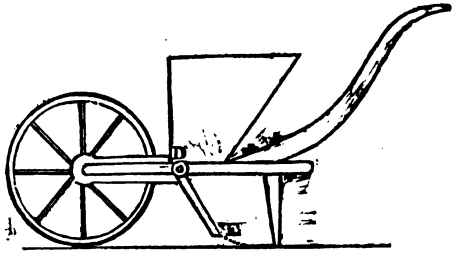
ing meetings of the Royal Institution, is briefly as follows:—"Let a number of thick copper rods or strong wires be laid below the public road, between two distant towns, and let them be connected with the wires of delicate galvanometers in each of the towns. If a number of letters, with the usual abbreviations, be applied to those needles, they will, of course, be put in motion by the passage of powerful voltaic currents. By observing the needles, which are successively put in motion in one of the towns by a current sent along the proper wire from the other, it is obvious that a newspaper, printing in London, may be printed at the same time in Edinburgh, and other remote towns."—*Quarterly Journal of Science, for March* 1830. Mr. Ritchie is reported to have added, that "as experiments have not yet been made with *thick* wires of *sufficient length*, and batteries of *(sufficiently)* intense powers, we cannot pronounce, with absolute certainty, with regard to the success of this ingenious project." Mr. Ritchie is right; the whole difficulty of the case consists in getting batteries powerful enough to produce a voltaic current abundant enough, to be transmitted by means of wires thick enough, and long enough, through miles of space. Were it as easy to transmit an electric shock from London to the Land's End, as from the attic of a house to the cellar, there would be an end of doubt and speculation on the subject. We should at once have electro-magnetic telegraphs in every city and town throughout the kingdom; the debates in parliament reported as soon at John O'Groat's House, as at the Thatched House in Westminster; and the last dying words of those who suffer for their country's good, at Newgate, re-echoed through the remotest wilds of Connemarra, before the breath was out of their bodies. But all the experiments hitherto made (and they have been neither few nor inconsiderable) with a view to ascertaining the limits of electric transmission, have served to show that in this, as in innumerable other instances, there is all the difference between doing things on a small and a large scale, which there is between possibility and impossibility. About three quarters of a mile is, we believe (speaking from recollection), the utmost distance to which it has been hitherto found practicable to transmit an electric current artificially produced. We have no disposition to question the resources of science, but we apprehend there is experience enough on this particular point to justify us in considering M. Ampere's project as one which there is no chance of our ever seeing realized.

DRILL-BARROW.



Sir,—In your seventh volume there is an inquiry from "Ceres" for a self-depositing dibble, which has drawn forth a notice and promise of a description of a "sowing machine," from "Mr. Peniston, of Goldthorpe Mill," at page 149 of the same volume; but as this promise, to the best of my recollection, has never been fulfilled, and the machine, of which I now send you a description, appears much more simple and less expensive, you will

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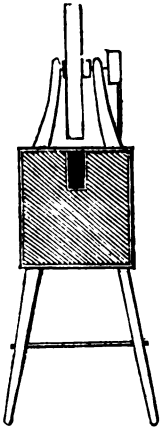
not, perhaps, as the time for sowing spring corn is now fast approaching, refuse it a corner in the "Mechanics' Magazine," at your earliest convenience.

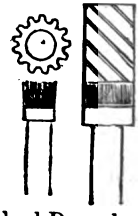
The drill-barrow, of which the accompanying figures are a representation, was first introduced into this country (Norfolk) about 30 years back, by the Rev. Mr. Munnings, of Gorgett, near East Dereham, who, it appears, originally had it from the Rev. Mr. Lindsey, of Lincolnshire, afterwards Lord Bishop of Killaloe. Whether or not this gentleman was the original inventor, I am unable to say, nor is it of much consequence; I have somewhere either seen or heard it called "Knight's" drill-barrow. The construction, as will be seen by reference to the above figure, is extremely simple. Fig. 1 is a profile; fig. 2, a bird's-eye view;

Fig. 2.



and figs. 3 and 4, edge and profile views of the brush and seed-wheel.

Figs. 3 and 4.



The seed-wheel D, as shown at fig. 1, is connected with the wheel of the barrow, and turning with it, allows the seed from the barrow to fall into the grooves or hollows, as shown at figs. 3 and 4, and this passing through the pipe E, is deposited in the ground. The brush applied at top prevents the clogging of the grooves, and pushes the grain out of them. Different sized grooves are used for different seeds; the wheel is moveable.

I am, Sir,
Yours, &c.
J. O. B.

Norwich, Feb. 20, 1830.

PHYSICAL ESSAYS.

No. 1.

On Matter and its General Properties.

All the varieties of creation may be arranged under one or the other of these two classes—matter or spirit. The first of these classes includes all inanimate creation, and the organized parts of intelligent and unintelligent animate beings.

The consideration of matter, its properties, and the various resulting phenomena, constitutes the science of physics.

Astronomy, chemistry, optics, geology, mineralogy, botany, mechanics, ærology, or pneumatics, and many others, are great and important parts of physical science; and to these sciences, taken collectively, the term physics is strictly applicable. Sometimes, however, it is used to express one of its own subdivisions, and is limited to the consideration of matter in the abstract, and its various properties. It will be used in this sense in the following essay, unless otherwise stated.

It is generally considered that the different properties of matter inhere in a "*substratum*:"—"a secret something which has hitherto eluded all human research and observation." Before I can admit this substratum doctrine, I must know how that "which has hitherto eluded all human observation or research," has become an object of human knowledge. But supposing this difficulty removed, what shall we say of the reasoning by which the doctrine is supported? The following is advanced by a modern

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metaphysical writer as a proof of the existence of a substratum.—Impenetrability, divisibility, extension, figurability, &c., are properties of iron: yet these several properties, whether taken separately or collectively, do not suggest the idea of iron. It therefore follows, that there exists a substratum in which these and other properties inhere, the idea of which joined to that of the different properties constitutes the idea of iron.

Let it be observed, that the above are general properties of matter; and, therefore, belonging to all matter, cannot suggest the idea of any particular species. But if a full and complete enumeration of the properties of iron be made, I submit that the idea of iron will be suggested, and, consequently, that the substratum doctrine being built on a train of reasoning thus shown to be erroneous, falls to the ground. Philosophers having been accustomed to consider the properties of matter abstractedly, have been insensibly led to consider them capable of a separate and independent existence: and hence has followed the idea that these properties alone are the objects of sensation, whilst matter itself is beyond our observation.

Having, then, I conceive, established the fact that matter itself is the object of sensation, I proceed to consider its properties.

The properties have been divided into general or universal, often, but improperly, called essential, and accidental or specific.

"Some late writers," says Dr. Brewster, in his notes to Ferguson's Lectures, "have increased the general properties of matter to twelve; namely, *extension, divisibility, figurability, impenetrability, porosity, rarefactibility, condensibility, compressibility, elasticity, dilatibility, mobility, inactivity.*"

In considering the properties of matter, it is necessary to distinguish between those which belong to aggregate matter, and those belonging to the ultimate particles of which that aggregation is composed. Before this distinction can be made, it will be necessary to see how far we can establish the doctrine of indivisible atoms in opposition to that of the infinite divisibility of matter.

The task is one of no small magnitude, and in attempting to unravel this truly Gordian knot, I have often been so completely baffled, that I have been inclined to discontinue my attempts. The invalidity of the arguments by which the doctrine of the infinite divisibility of matter is supported, is easily shown: but I wished to prove, what those few philosophers who have advocated the opinion have assumed as a postulatum, and held with considerable doubt as to its truth, that matter is not capable of infinite division. By a close and patient investigation of the subject I have at last succeeded; or, at least, I can now support my opinion by arguments satisfactory to myself. These I will state as clearly and briefly as I can.

"The fourth property of matter," says Ferguson, "is divisibility; of which there can be no end. For, since matter can never be annihilated by cutting or breaking, we can never imagine it to be cut into such small particles, but that if one of them be laid on a table, the uppermost side of it will be farther from the table than the undermost side."

In dividing matter we overcome attraction by attraction, the less by the greater. Of the different degrees of attractive force, one is least, another greatest. This greatest cannot be overcome by any physical force, and any number of particles between which it exists will constitute an extended mass, and exhibit exactly the same phenomena as though they were essentially one. I admit the correctness of the usual mathematical reasoning on this subject, as proving the infinite divisibility of *extension*, but contend for its invalidity as a proof of the infinite divisibility of *matter*. In reply to my argument of the greatest attraction, it may be objected that it proves the finite divisibility of only a small portion of matter, namely, that which exerts a greater cohesive force than any other, whilst the legitimate though indirect inference is, that the remainder, that is, the greater part of matter is capable of infinite division. By no means;

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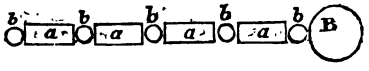
and for this reason. Great and small are relative terms; and the force *a*, which is greatest in reference to the force *b*, may be least in reference to the force *c*. I now state my main argument, which arises out of the preceding observations, and which I must illustrate by a diagram. Suppose that a given quantity of two bodies capable of exerting upon each other that heterogeneous force which will overcome the homogeneous or cohesive force of each, and which is greater in one than the other, be taken—a separation of the particles of each, and a mutual interposition ensue. Thus let *aaaa* be four particles of matter having a stronger cohesive force than the five particles *bbbbb*.



In order to effect a farther separation of the five particles *b*, which before constituted the mass B, a farther interposition of the particles *a* must take place. But how is this to be done? The only existing force is that of the particles *b*, which by the terms of the case is less than that of the particles *a*, and therefore insufficient. It will be asked, how were the particles *a* originally separated, that separation having been a consequence of the mixing of *a* and *b*. They were separated by the mutual heterogeneous or chemical force, which being finite, cannot effect an *ad infinitum* division.

Hence I conclude, 1st. That the reasoning hitherto used in proof of the infinite divisibility of matter applies only to extension. 2ndly. That however great may be the difference of the homogeneous attraction of each of any two bodies brought into contact for the purpose of effecting division, the consequent division will be *finite*, because it is mutual. And, 3rdly. That the ultimate particles, that is, the smallest particles into which a mass of matter can be separated, are extended, and consequently possessed of all those properties arising from extension.

From extension, which we are justified in considering to be a property of the ultimate particles as well as of aggregate matter, follows *figurability*.

The figure of aggregate matter is infinitely diversified, and depends upon the arrangement of the ultimate particles of which it is composed. In the generality of phenomena, the figure of bodies is of minor importance: electrical phenomena, however, present a striking exception. The figure of the ultimate particles or atoms depends upon a different cause, and being in all probability very influential in many phenomena, is an interesting subject of inquiry, but from want of data, all speculation is almost unavoidably visionary.

The fourth property of matter, *impenetrability*, is that by which a particle or mass of matter excludes another from occupying the same part of space. This definition is given by Nicholson, in his "Natural Philosophy," who, nevertheless, after a few remarks in favour of the existence of ultimate particles observes, "to these ultimate particles it is that the property of impenetrability must be ascribed. Penetration takes place in all compounded matter: thus water penetrates sponge, wood," &c. Sponge, wood, and the other bodies mentioned by Mr. Nicholson, are porous; into the pores the water is imbibed: and it therefore occupies the space previously unoccupied, and does not penetrate the solid particles of the sponge or wood.

If a man being blindfolded were to approach a large loadstone with a piece of iron, he would from the opposition he would meet with from the magnetic repulsion, conclude that he was directly opposed by a solid mass. Repulsion being considered to exist between the particles of matter, some philosophers have thought that impenetrability depends upon it, and if this repulsion did not exist, that the particles of matter would be mutually penetrable. This opinion may be thus stated: two particles of matter, *a* and *b*, may together occupy the space of *a* or *b*; that is, $a+b=a$ or $a+b=b$: in other words, that the whole is equal to one of its parts; which is absurd. Nicholson asks—why place an impenetrable atom in the centre of a sphere

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of repulsion? Why an atom should be placed in the centre of this sphere, is a question which cannot with propriety be considered here; but admitting that the atom does exist, I contend that though the supposed sphere of repulsion may be the cause of that impenetrability which comes under the cognizance of our senses, yet that the impenetrability of the atom is a necessary consequence of the mathematical axiom, that the whole is greater than one of its parts.

Porosity, in the vulgar acceptation of the term, is that property by which sponge, for instance, absorbs water, or charcoal absorbs gases. By philosophers it is used to denote that arrangement of the constituent particles of a given mass of matter, by which vacuities are formed between these particles, but notwithstanding which, the body presents the appearance of a connected whole. This appears to me to be the more correct acceptation of the term, because in the first is included the operation of a species of attraction.

We have heard of the "Iliad" having been enclosed in a nut-shell; but this, however surprising, is a mere nothing in comparison with what might be effected, if an opinion generally advanced by philosophical writers, when treating on porosity, is correct: for according to them, by far the greater part of apparent material bulk is only vacuity, and that, in all probability, all real matter if united in one solid mass would occupy a very small part of space. This opinion cannot be considered otherwise than as an ingenious whim unsupported by any rational evidence.

Rarefactibility, *condensibility*, *compressibility*, *elasticity*, and *dilatibility*, should be struck from the list of the general properties of matter, because they are the consequences of the property of mobility: if we admit them, we might with equal propriety include visibility and tangibility, which are the consequences of extension; and so of the rest. Rarefactibility and dilatibility are terms expressive of the *same* effect produced by *different* causes: the same may be said of condensibility and compressibility; and I therefore think that *two* terms are more proper than *four*.

These secondary general properties are considered by some writers as the results of the repulsive power of caloric, and the mobility and mutual attraction of the material particles; by others, both the attraction and repulsion are thought to inhere in the same particles.

Mobility and *inactivity* furnish interesting subjects of inquiry. Matter is generally considered to be inert; and the opposite opinion has been thought to lead to very dangerous theological conclusions. That which is physically true cannot be morally false: that which is not morally false, is not anti-scriptural. We cannot suppose that a single isolated atom, possessing extension and impenetrability, would in consequence of these properties also possess motion; but there does not appear to be any thing derogatory to the omnipotence of the Creator in the supposition that He could so communicate motion to matter, that it should continue in motion without requiring His continual and immediate agency.

Attraction is considered by some as the cause of all material motion. Now, let it be observed, that the power of attraction is mutual, and that that body which is attracted, also attracts; and therefore if it is allowed that the power of attraction is inherent, it must be admitted that an inherent activity also exists. To obviate this objection it has been argued, that attraction, as for instance of gravitation, is a force which gradually diminishes, and would ultimately be annihilated unless fresh and continual supplies be afforded. This strange notion, which neither unties or cuts the knot, involves the supposition that the attraction of gravitation is a distinct essence, flowing as a kind of stream or effluvium from matter: a supposition having no physical fact for its foundation—a supposition most unphilosophical and preposterous.

The best and in my opinion (for I by no means advocate the essential activity of matter) the true opinion is, not that attraction is the cause of motion, but motion the cause of attrac-

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tion, and that this motion is in all probability the result of the immediate operation of an omnipresent and essentially active Being.

But the determination of this point does not fall within the province of the physical philosopher. To him, matter presents all the phenomena of activity; attracts, repels, expands, burns, and in a thousand varied motions presents important, useful, and interesting subjects of investigation: at the same time manifesting the wisdom, the power, and the goodness of its Creator.

I hasten to a conclusion. Matter is itself the object of sensation, existing in masses varying in size and figure, possessing the general properties of extension, porosity, and mobility, and composed of particles or atoms possessing extension and mobility.

Extension causes the secondary general properties of figurability and impenetrability: mobility operating in conjunction with different attractive and repulsive forces, causes rarefactibility, elasticity, and compressibility: these are secondary general properties of aggregate matter, which also possesses the property of finite divisibility. The ultimate atoms are impenetrable, figured, and indivisible.

In my next Essay I propose to consider homogeneous or cohesive attraction as introductory to Essays on the abstract nature of heat, and some other interesting subjects of physical inquiry.

H. H.

(To be continued.)

THE PLANET PALLAS.

We extract the following interesting piece of astronomical information from a letter in *The Times*:—

"By reference to the Berlin or Encke's Ephemeris, the planet Pallas was detected here last night. She has the appearance of a star of the 8½ magnitude, is of a bluish tint, and bears but a very feeble illumination. Her right ascension when on the meridian of my observatory (54′ 21″ west of Berlin) was 15 hours 22 49″ and $\frac{1}{100}$; and her northern declination was 17° 43′ and 45″. Hence her place, as given in the Berlin Ephemeris, affords data sufficient for finding her; but as that excellent work cannot, I believe, now be purchased in this country, the following extract will be useful to those who take interest in such matters.

F. R. S."

April 7, 1830.

Extract from Encke's Ephemeris.

		R. A. h.	m.	s.	N. Decl. deg.	m.
April	6.—15	22	0		18	14
	10.—15	19	9		19	20
	14.—15	17	5		20	21
	18.—15	4	8		21	19
	22.—15	11	8		22	13
	*26.—15	8	7		23	1
	30.—15	5	4		23	43
May	0.—15	5	4		23	43
	4.—15	2	1		24	19
	8.—14	58	8		24	50
	12.—14	55	5		25	14
	16.—44	52	4		25	32
	20 —14	49	5		25	44
	24.—14	46	7		25	50
	24.—14	14	2		25	51

THE PLANET CERES.

The following information with respect to another of the new planets, is contained in the letter of a second correspondent of *The Times*:—

"On Friday night last, (9th April) at 12 hours 48′, sidereal time, the planet followed the star Bode Libræ, 3″ $\frac{1}{10}$, and was 6′ 46″ of a degree to the south of it. On Saturday night, at 14 hours 56′, she preceded the same star 13″ $\frac{7}{100}$, and was 4′ 8″ $\frac{5}{100}$ to the south of it. Clouds prevented me observing it on the meridian. Applying these quantities to the place of 82 Bode Libræ, the data furnished by Encke's, or the Berlin Ephemeris, are, I find, amply sufficient to enable the observer to direct his instrument to the spot which the planet occupies in the heavens. She has the brightness of a star of the seventh magnitude, has no peculiar colour, and can

* Day of opposition.

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only be distinguished from the star 82 Bode Libræ, by her motion. She is almost 4° south of β Libræ, and precedes it about 6′ of time; hence the field of the finder being 4° in diameter, if β Libræ be brought into the lower part of the circumference of the field, Ceres will be found in the upper."

The following computations for this planet, for April and May, are from Encke's Ephemeris:—

	R. A.			S. Decl.		
	h.	m.	s.	deg.	m.	s.
April 18.—	14	54	31	4	30	12
20.—	14	52	52	4	26	2
22.—	14	51	9	4	22	7
24.—	14	49	24	4	18	29
26.—	14	47	38	4	15	9
28.—	14	45	50	4	12	11
*30.—	14	44	1	4	9	36
May 2.—	14	42	12	4	7	24
4.—	14	40	23	4	5	39
6.—	14	38	35	4	4	20
8.—	14	36	47	4	3	30
10.—	14	35	2	4	3	9

* Day of opposition.

THE SOCIETY FOR PREVENTING THE LOSS OF LIFE BY FIRE.

Sir,—I shall feel obliged by the insertion of a few remarks occasioned by Mr. Baddeley's statement (in No. 347), of the progress of the Society for Preventing Loss of Life by Fire. The vein of ridicule which pervades the greater part of Mr. Baddeley's communication, I shall forbear to notice. That Mr. Baddeley would have achieved more than I have been enabled to accomplish is possible, and that the subject was not taken up by one more competent than myself I much regret. With respect, however, to any new undertaking, it may be remarked that its success is frequently retarded by a similar feeling among the public generally, to that which Mr. Baddeley expresses (at page 70) to be his own; viz. "Feeling a deep interest in the success of the newly-established society, and anxiously *expecting the time* when he might have personally assisted in the praiseworthy object."

Whenever success in an undertaking is evident, there are always plenty to assist; but so long as the task remains difficult, there are others ready to taunt and throw impediments in the way.

In reply to the charge of "hunting after machines instead of men," it will, I presume, be admitted that the first step towards either men or machines, should be to raise a fund: With this view, the public exhibition of models took place. It was attended by as many persons as the room would hold, and judging by the expressions of applause, they were well pleased with the proposed object, and the skill displayed by the several exhibitors. Notwithstanding this, the amount of subscription was very trifling, indeed not enough to clear the expenses. The conclusion drawn from this was, that it would be desirable to have an instrument or machine constructed, in order to convince the public of the possibility of effecting the object intended.

The description of the machine given by Mr. Baddeley is altogether an exaggeration,* and the alteration stated to have been made to render it lighter is untrue, as is likewise the assertion that the society's money has been squandered. With respect to Doyle's machine, it was at *his own risk*; and I am much deceived if a better than that of Wild's, on which Mr. Baddeley has expressed so hasty an opinion, is likely to be offered. That it might be improved there is no question, and such is usually the case with works of every description; but that a less cumbersome machine can be made, capable of being so generally useful for the purpose intended, I have much doubt.†

* Whatever similarity there may be in any part of Wild's machine to any one of Gregory's, I am satisfied the former is not indebted to the latter. In the production of a new invention, it has frequently occurred that the ideas of two persons have been so near alike, that each suspects the other; it was so with respect to Davis and Gregory's sliding-ladders; and much of the arrangement of the new police bears so great a resemblance to my suggestion, contained in No. 237, that, if so inclined, I might entertain the notion that those suggestions were made use of.

† Ladders, to be effectual, require tackle, to adjust which, a greater length of time would be lost than by the process of raising the receptacle to the machine alluded to.

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If such machines were stationed every night at distances of two-thirds of a square mile, under the care of two men, and the new police were allowed to act in concert with them, there would be no necessity for the greater number of men as first proposed. As a security for houses in confined situations, it would doubtless be advisable to subdivide each district, and to deposit apparatus with rods, &c. To go into detail, however, is not here intended, but merely to account for the alteration in the number of men as before mentioned, and to show that Mr. Baddeley has relied too much on hearsay assertions.

I am, Sir, yours, &c.
JOHN HUDSON.

April 7, 1830.

MISCELLANEOUS.

A Mode of Ferrying has been recently patented in America, which might, we think, be introduced with advantage in many parts in this country. It is thus described: A paddle-wheel like that of a steam-boat is to be placed on one side of a river, and is to be driven by the current. The shaft of this wheel carries two cog-wheels, which may alternately be made to take into a wallower, and turn it in opposite directions. On the same shaft with the wallower there are two drums, to each of which a rope is to be fastened, and around each a portion is to be coiled; this rope is also to extend double across the river, and pass round a pulley on its bank. To the middle of this rope the ferry-boat is attached, when it may be sent over and returned by a man who attends the wheel, and engages and disengages the wallower.

Explosion of Steam-Boilers.—At a sitting of the French Royal Academy of Sciences, on the 25th of January last, M. Noel announced that Mr. Perkins (now in France) had been led by various observations to the conclusion, that one of the most frequent causes of the explosion of steam-boilers is the heating to redness of parts of the metal, and that this again is often occasioned by the viscous nature of the water employed—this viscidity preventing the free disengagement of the steam. In order to obviate these sources of accident, Mr. Perkins proposes to introduce an agitator into the interior of boilers, which shall at once break the viscidity of the water, and dash it incessantly against the sides of the boiler, so that no part shall get more heated than that which is covered with the liquid.

The Non-Conducting Power of Sand is so great, that in eastern countries, when the surface of a bed of sand at mid-day is too hot to allow the hand to remain in contact with it, the temperature, at the depth of a few inches, is gratefully cool. During the celebrated siege of Gibraltar, the garrison turned their knowledge of this fuel to good account. The red-hot shot employed to destroy the Spanish floating-batteries was placed in wooden barrows on layers of sand, and thus carried from the furnaces to the batteries, without the wood once catching fire.

Declination of the Needle.—The declination of the needle (its deviation from the meridian), continues to diminish in 1829. It thus appears to be now decided that the retrograde movement which was begun to be observed in 1816, is not simply in accidental irregularity, but that the north pole of the needle, which from 1666 to 1816, had continually deviated from the meridian towards the west, has since approximated to it every year. From November 1828 to November 1829, the amount of the retrogradation has been 2½ minutes. On Saturday, the 30th October, 1829, at 2½ hours after mid-day, I found at the extremity of the garden of the observatory, far from any mass of iron which could affect the result, that the absolute western declination was 22° 12′ 5″.—*M. Arrago—Annales de Chimie.*

Inclination of the Needle, (its dip below the horizon, first noticed by Robert Norman, a compass-maker at Ratcliffe.)—While the declination of the needle retraces its steps, the inclination continues to approach gradually to the horizontal. The mean of a number of observations made in the garden of the observatory on the 12th, 21st, 22nd, and 24th June, 1829, at 2½ hours after mid-day, gives for the present amount of the dip, 67° 41′ 3″.—*Ibid.*

Baltimore and Ohio Rail-Road.—The length of this rail-road when completed will be 180 miles, and there will be but one summit in the whole line requiring stationary power. The estimated expense is 20,000 dollars per mile. The bridges are all built of stone. One over Gwynns Falls consists of a single arch of 80 feet span, with an elevation of 58 feet to the top of the parapet, and 300 feet in length. Another across the Patapsco has two arches of 55 feet span each, and two of 20 feet span; it rises 46 feet high, and is 375 feet long. The deepest cut will be 79 feet, and the highest embankment 57 feet. In one place the road has been carried through a solid mass of rock rising 58 feet above its surface.

Fire-Extinguishing Machinery.—Among the many defects which have been pointed out in this journal, in the arrangements adopted in London for the extinction of fire, one of the most inexcusable is the want of uniformity in the connecting screws of the hose of the different engines. The "Mechanics' Magazine," published at Boston, in the United States, after quoting our observations on this head, and adding a few well-merited notes of admiration, states, that not only is the hose used in the whole of the fire-department in that city made to connect by screws, but that the hose of the engines of the neighbouring towns of Roxbury, Charlestown, and Cambridge, is all made to fit that of Boston, whence "numberless advantages," in point of facility, are obtained. Verily! we of this ancient city have yet much to learn.

INTERIM NOTICES.

Communications received from J. B. J.—A Practical Engineer—Mr. Russel—E.—H.—C. D. S.—D——n F——s—Echo—A Constant Reader at Ludlow—F. L. M.—B. S.—A Constant Subscriber—Omicron—Mr. Harrison—A. Z.—T. T.—J. Hope.

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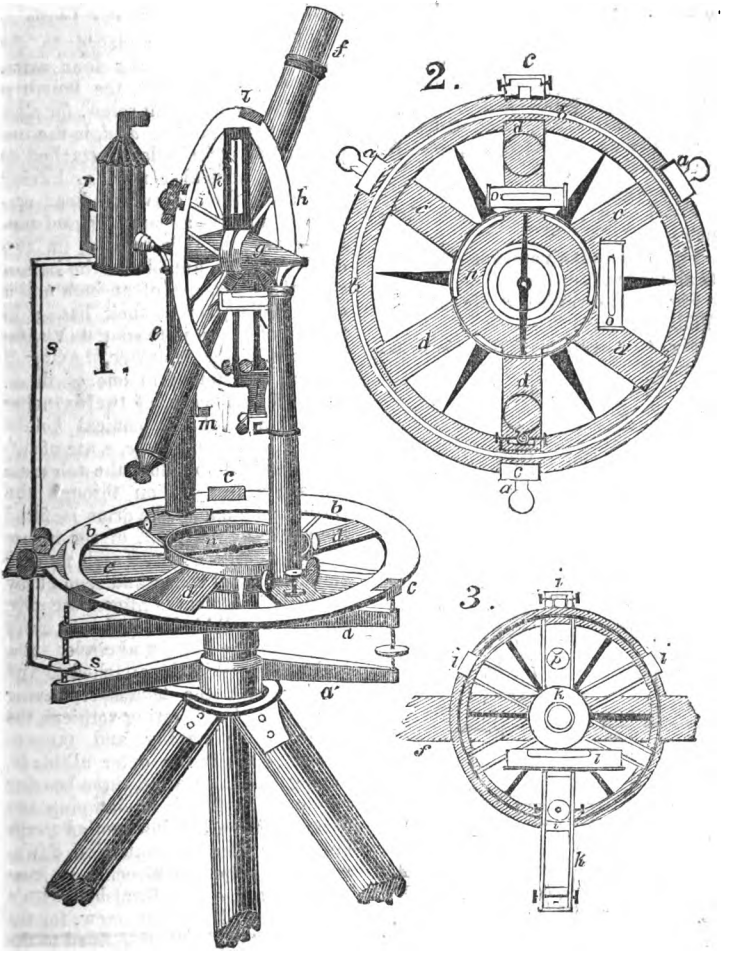
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 350.] SATURDAY, APRIL 24, 1830. [Price 3*d*.

HASSLER'S REPEATING THEODOLITE.



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HASSLER'S REPEATING THEODOLITE.

The theodolite represented in the accompanying engravings was constructed under the direction of Mr. Hassler, an eminent American astronomer, by Mr. Richard Patten, instrument-maker, of New York, for the use of the Discovery vessels recently fitted out by the government of the United States. The following description of the engravings is from the pen of Lieutenant Charles Wilkes, of the United States' navy, who, in an introductory letter to Professor Silliman, represents the instrument as exhibiting as near an approximation to "perfection in principle as it is possible to arrive at—compensating not only for faults of workmanship, but for errors of observation."

Description.

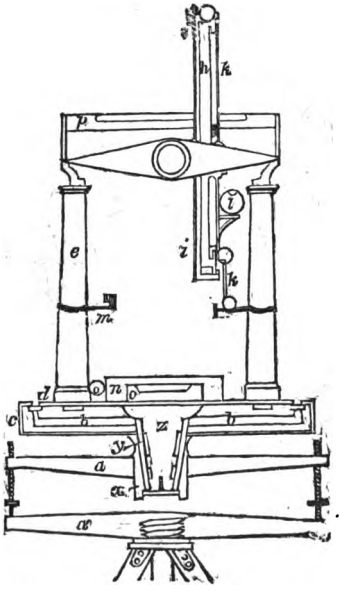
Fig. 1 is a perspective view of the instrument.

Fig. 2. The horizontal circle with its alhidades, &c. &c.

Fig. 3. The vertical circle with its alhidades, &c.

Fig. 4. A section of the whole instrument.

Fig. 4.



The letters of the perspective view answer to those of the sectional parts.

a, *a*, *a*, are three horizontal radii of six inches radius, in the ends of which are simple levelling screws, which fit in sockets on similar radii, *á*, *á*, *á*, screwed to the top of a three-legged stand, which serves as the support of the instrument in the field. *b*, *b*, is the horizontal or azimuth circle, of nine inches diameter, with a silver arch attached to the middle conical centre, *y*, divided and read off, by means of verniers, to fifteen seconds. *c*, *c*, is the lower or standing alhidade, attached to the outer centre, *x*, having four arms, three bearing verniers, the fourth a clamping and tangent screw, for slow motion to the circle. *d*, *d*, is the upper or moving alhidade, attached to the inner conical centre, *z*, having four arms, three of which bear verniers, the fourth a clamping and tangent screw, for slow motion; on two of these arms are placed the hollow conical pillars, *e*, *e*, of an inch and a quarter diameter at their basis; to the top of these is fixed the Y's, for the axis of the telescope, having a vertical adjustment in one of them. *f*, *f*, is the telescope, of twelve inches in length, with its conical hollow arms, *g*, *g*; the pillars, *e*, *e*, are of sufficient height to allow the telescope to have a free motion through the vertical; on one of the arms is fitted the vertical circle, *h*, *h*, of six inches diameter, with a silver arch moving on a bell-metal collar, and read off by means of verniers to fifteen seconds, having two alhidades similar in every respect to the horizontal circle. *i*, *i*, is the inner alhidade, attached to and moving with the telescope, having four arms, three bearing verniers, the fourth the clamping and tangent screw. *k*, *k*, is the outer alhidade, having also four arms, three bearing verniers, the fourth a clamping and tangent screw, for slow motion to the circle, the fourth is extended downward to a projecting piece, *m*, *m*, from the pillars, *e*, *e*, and furnished with a clamping and tangent screw, for the adjustment of the level, *l*, fixed to the outer alhidade. On the upper horizontal alhidade is placed a compass, *n*, *n*, for the magnetic bearings, and two small levels, *o*, *o*, for adjusting the instrument more readily. *p*, *p*, is

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a larger level for the adjustment of the axis of the telescope, which passes through the arms of the vertical circle and its alhidades, and rests on the axis of the telescope, as shown in fig. 4; it is removed after adjustment. An illumination is effected through one of the conical arms, *g*, *g*, by means of a small lamp, *r*, fastened to a support, *s*, *s*, that is attached to the three-legged stand, by which it is detached entirely from the instrument, and of course can have no influence on its adjustments.

The centres, collars, and axis, are all of bell-metal truly turned. The triple centre work, of different sized cones, moving in each other, is a very great improvement, giving great solidity and little friction, and making the instrument susceptible of any number of repetitions.

WEBSTER'S ENGLISH DICTIONARY.

Sir,—In the last Number of your valuable publication, p. 94, you have referred to Dr. Webster's *English Dictionary* in these terms:—"Dr. Webster's admirable edition of Dr. Johnson's *Dictionary*,—the best edition certainly, which has ever yet appeared, and which we are glad to observe, is now republishing in this country." As the English Editor, permit me to remark, that you are under a misapprehension in considering this work to be an edition, though a very greatly improved edition of Dr. Johnson's *Dictionary*. It has far *higher* claims, and is, in truth, entitled to be regarded as an *original* work of extraordinary merit, constituting a new era in English lexicography, and supplying the grand *desideratum* in English philology. It was the labour of *thirty years*, the golden fruit of *forty years'* study of the English language. Every page attests the learning and talents,—the sound judgment and nice discrimination,—the great industry, profound research, and surprising perseverance of the author. Microscopic criticism may detect faults and deficiencies, (which the English Editor will be ready to correct and supply, when they are pointed out), but the substantial merits of the work will ever entitle it to the commendation, which you have bestowed on it. The British public have already discerned its excellencies, and though the work was the production of a foreigner, whose name could scarcely have been previously known even to our best English philologists, the cover of the *second* Number, just published, exhibits a list of 547 subscriptions, and contains the names of many eminent literary characters, who have expressed high approbation of the work.

For the information of your readers, I will state the prominent advantages of the book.

1. The vocabulary is greatly enlarged; *twelve thousand words* have been added to Johnson.

2. It contains an explanation of terms peculiar to American laws and institutions, manners and customs.

3. An explanation of technical and scientific terms according to the *present* principles of art and science. It is thus distinguished from my excellent and learned friend, the Rev. H. J. Todd's edition of Johnson's *Dictionary*, which was itself a great improvement in English lexicography, but which is either very defective in these respects, or very abundant in *exploded* matter; and it thus becomes a sort of *Encyclopædia in Miniature.*

4. The definitions are full, clear, precise, and correct, expressed with great terseness, and noticing the synonyms, so as in most instances and for ordinary purposes, to supersede the necessity of consulting a book of synonyms.

5. It exhibits regular systems of orthography and orthoepy, founded on the justest analogies and the soundest principles; and thereby supersedes the necessity of consulting Walker's *Pronouncing Dictionary*, which, though still very popular in this country, ought, from the viciousness of its system, to be expelled from our schools and academies. In these respects Dr. Webster's work will be of the greatest possible service to the community, more particularly to the natives of Scotland and Ireland, and to foreigners, who are studying the English language.

6. It displays the origin and affinities of words, tracing them in the

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most satisfactory manner, and in a spirit of most extraordinary research, through various languages, Oriental and European. Thousands of philological questions, interesting to antiquarians and scholars, are solved most ably; and where Dr. Webster, in cases of difficulty and doubt, warily ventures to give no *decided* opinion, he nevertheless points attention to the *probable* sources of the words in question. All who are fond of such investigations, philological or philosophical, cannot fail to find in this part of the work an endless source of enjoyment. Though the utmost brevity is employed throughout the work, yet Dr. Webster dismisses few topics of etymology without an ample discussion, and in points of importance he hesitates not to bring forward all his lingual knowledge, and to exercise the best powers of his mind in settling them with impartiality.

7. The *Introduction* contains a *Dissertation on the Origin, History, and Connexion of the Languages of Western Asia, and of Europe*, which cannot fail to attract the attention of grammarians, and linguists, and philologists, but on which I am not qualified to pronounce any opinion.

8. *The English Grammar, philosophical and practical*, is entirely new, *not* a reprint of that, which Dr. Johnson prefixed to his *Dictionary;* and on examination it will be found to be very far superior to any of our English Grammars by Dr. Priestley, Bishop Lowth, &c. &c.

9. The work will be published in twelve Numbers, of which two have already appeared, at intervals of two months. The subscription price, (of which the public should hasten to avail themselves), is so reasonable as to have excited much surprise in some quarters; the paper and type are excellent; and the *getting-up* of the work reflects the greatest credit on Mr. R. Taylor's press. In these respects it will probably be thought superior to any Dictionary in existence.

Such a work as I have described, must be regarded as a most proper book to be introduced into *Mechanics' Institutes*, and recommended to the notice of scientific men, who wish to arrive at the information, which may be required for their purposes, with as much expedition and at as little expense as possible. The march of mind and the progress of knowledge will be greatly advanced by granting to the student or the proficient free access to this valuable work.

I am, Sir, your well-wisher,
And respectful servant,
E. H. Barker.

Thetford, April 16, 1830.

[We are scarcely sorry for the inadvertency of which we were guilty in regard to the originality of Dr. Webster's Dictionary, since it has given occasion to the able and satisfactory exposition of its merits, which we have now the pleasure of laying before our readers, from the pen of the learned Editor of the English Edition, and also to the cordial testimony in its favour which we inserted in our last Number from a subscriber to the work. We perfectly agree with both gentlemen in all that they have said in its favour. It is a work which no Mechanics' Institution should be without.—Ed. M. M.]

SQUARING THE CIRCLE—APPROXIMATE METHODS DISCOVERED BY MAJOR-GENERAL OUSELEY.

Sir,—In a conversation I had some days ago with Major-General Ouseley, he mentioned several new approximate methods which he had discovered for finding the area of a circle. One of his formulæ was as follows:—Suppose $d =$ diameter; then $d^2\left(\frac{1}{28\frac{1}{4}}+\frac{3}{4}\right)$ or $\left(\frac{4}{113}+\frac{3}{4}\right)d^2 =$ area of the circle very nearly. Thus if $d=1$; then $\frac{4}{113}+\frac{3}{4}=.7853982$ +, which is true to six places of decimals, and the seventh only differing by 1. The General has several other methods, more or less correct than the above. By what process he discovered the above, or any of his other methods of approximation, he did not explain to me. But farther, the General contends that he can geometrically construct a square that will be equal in area to that of a circle of a

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given diameter. His method of doing this he explained to me, and it is simply this. Suppose the length of a cylinder is ¼ of its diameter: let the cylinder roll upon a plane surface until it has made *exactly one revolution;* it will then evidently generate a rectangle, one side of which will be equal to the circumference, and the other equal to the length of the cylinder. Now, as the area of a circle is exactly expressed by the rectangle contained by its circumference and ¼ of its diameter: hence the rectangle thus generated will be exactly equal to the area of either of the circular ends of the cylinder; therefore, a mean proportional between the sides of the rectangle will be the side of the required square whose area is equal to that of the circle. How far the General's method may be considered geometrically correct, I will not take upon me to decide. I would wish much to have the opinion of some of your scientific contributors on the matter.

I am, Sir,
Yours, &c.
AMICUS.

P. S.—There is a misprint in my question, No. 343. Instead of the sun's declination being 22′ 50″ N., it should have been 22° 50′ N. Also for diameter *read* semidiameter.

THE REPLY OF "A PRACTICAL ENGINEER" TO MR. GILMAN'S "REFUTATION," CONCLUDED.

Sir,—I must beg leave to trespass a little farther on the attention of your readers, while I reply to the conclusion of Mr. Gilman's "Refutation," as contained in your 345th number.

Mr. Gilman says, that in my second communication, I asserted that he (Mr. G.), meant "joints of two feet diameter:" and adds, "it is clear, however, that I neither did, nor could mean this, but a hundred joints of such narrow widths as 3-8ths of an inch." Now, as no other joints than those of two feet in diameter were spoken of either in Mr. Gilman's narrative, or in his reply of 4th January to my remarks, it was surely fair to suppose that he meant such; and certainly if he could make one joint sound of *less* than 3-16ths of an inch wide, to retain steam of 300lbs. pressure on the square inch, in a vessel two feet in diameter, with only 12 bolts 3-4ths of an inch thick, he could make an hundred such. Why then does he express himself so angrily?

He farther assures us, that when speaking of fuel in a state of ignition, he only meant that a *sufficiency* was in that state, and not *the whole.* But if the reader will refer to Mr. G.'s narrative, he will find that he not only said *in so many words,* that "the method of operating" was "first to fill the fire-chamber *full* of fuel," which fuel afterwards "acquired a state of intense ignition," &c.; but that he gave us a drawing, in which the *whole* of the fuel, not a *sufficiency* only, appears in that state of *intense ignition.* Mr. G. adds, that "the object in filling the chamber full was for *store,*" &c. Now were we to adopt this new version of the matter, namely, that part of the fuel was to be in a state of ignition, and the remainder not in such a state, but in store merely, then it must be evident that the said *store* would have all the gas and tar distilled from it precisely the same as if it were in a gas retort. But would not in that case Mr. Gilman's pipes F, whose *outside* diameter is not more than 3-4ths of an inch, be instantly choked by the tar, and the dust and ashes blown from the fuel—to say nothing of the pitiable state to which the valves at the ends of the said pipes must be reduced by the process?

Mr. Gilman says, "no scoria, or slagg, ever accumulated," &c. I fully believe him, for I am perfectly satisfied that the whole thing is a chimera, and never was practised; and I again repeat my challenge to him, to prove by *competent witnesses,* that "*he ever, with that apparatus, and in the way he describes,* subjected the fuel to combustion under a pressure of so much as 1lb., much less of 300lbs. to the square inch, above the pressure of the atmosphere." This I shall always consider as the test to which I put Mr. Gilman.

The paragraph commencing "there is another charge of piracy," &c., exposes in an important way Mr. Gilman's total ignorance of the subject, which he pretends to have reduced to practice—ignorance arising from theory, and which never *could* result from practice. As I challenged him with having pirated Mr. William Wilmot Hall's patent, no doubt he supposes I consider Mr. Hall's invention (which is precisely the same as Mr. Gilman's last modification) to be good. No such thing; both Mr. Hall and Mr. Gilman have reasoned upon theoretical and mistaken prin-

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ciples. Mr. Gilman expresses his opinion that his last modification is *more valuable* than the others. Now what is this last modification? To avoid the charge of misrepresentation, we will copy Mr. Gilman's own words from your 330th number, page 260. "The last modification which I shall now notice, is the application of an exhausting apparatus over the surface of the water in which the flue terminates, instead of forcing the air into the fire; by this means a partial vacuum is formed above the surface of the water, equal to any required draught." Now, Sir, as an engine worked by a mixture of atmospheric air and steam must be upon the high-pressure principle, and as Mr. Gilman says, *a partial vacuum is formed above the surface of the water* (which I repeat is also exactly the principle of Mr. William Wilmot Hall's patent), it is quite clear that all the steam and air, or gases produced by that vacuum, must be of less elasticity and density than the atmosphere. How then, I ask, can the elastic mixture of such minor density move a piston (within a cylinder) when it is opposed by the more dense pressure of the atmosphere. If Mr. Gilman had exerted his ingenuity to increase instead of diminishing the quantity of fuel consumed in a steam-engine, he could not have succeeded more happily; for all the fuel in the universe, would not, if applied in this way, produce power sufficient to turn a piece of beef on a roasting spit.

Mr. Gilman, in alluding to Mr. *Samuel* Hall's apparatus, speaks of it as one "which the 'Practical Engineer' eulogizes as so superior," &c. What can he mean by making such strange statements? I have never said a word eulogizing either Mr. *William Wilmot* Hall's, or Mr. *Samuel* Hall's inventions, as every one must know who has read my letters.

To reply fully to the summing up paragraphs of Mr. Gilman's "Refutation," as it is pleasantly styled, would only be to repeat what I have stated in this letter, and that published in your 347th number. I will merely remark, that "the expansion of the internal cylinder, or fire-chamber" (which Mr. Gilman admits), is quite sufficient to prevent the *actual use* of the generator, without the many other uncontroverted obstacles which I have enumerated.

I am, Sir,
Yours respectfully,
A PRACTICAL ENGINEER.

March 23, 1830.

P. S.—The letter from Messrs. J. Jefferies and Co. states, that they furnished the castings for Mr. Gilman in May, 1826; Mr. Samuel Hall's patent, with which that gentleman acknowledges he is well acquainted, and from which, no doubt, he has taken his ideas, was granted two years before that time, viz. 8th April, 1824, and published in the "Register of Arts and Sciences," September 18, 1825, that being eight months before the castings were furnished. Messrs. Jefferies and Co., say one of them, saw it repeatedly after its erection; but they dont say they ever saw it *in operation*, so that I must, for the hundredth time, ask why does not Mr. Gilman at once bring some respectable persons to prove that his generator has been, as he has asserted, in actual operation?

Mr. Gilman addressed a letter to you in October 19, 1824, the following extract from which, I must beg of you to republish:—

"The results, however, of my investigations, though not yet concluded, have given rise to a perfectly novel combination of machinery, as a medium for applying the power of steam, widely differing from any thing that has hitherto been attempted; whereby, as appears from the calculation with which I have furnished you, the effect will be eight times greater from the same quantity of steam, and about fifty times more power will be produced from the same quantity of fuel, than what is obtained from an engine on the plan of Watt!!" &c. I should feel it a great piece of courtesy in Mr. Gilman, if he would inform me whether it was his notable patent, dated about six months afterward, *i. e.* April 13, 1825, (which has been so amply discussed in my letter, inserted in your 334th number,) or his last modification, that was to produce about *fifty times more power* "from the same quantity of fuel, than what is obtained from an engine on the plan of Watt." I suppose we must call Mr. Gilman's *last* like Lord Norbury's last, *i. e.* his *last joke*.

A FEW SUPPLEMENTARY REMARKS BY "A PRACTICAL ENGINEER" ON THE LETTER OF "A LOOKER-ON," (P. 89.)

Sir,—I am quite ashamed of troubling you so much upon a subject (Mr. Gilman's generator), with which, no doubt, you must be tired; but as S. Y. (an engineer) says, he shall be obliged to me if I will inform him how to make

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Mr. Gilman's annealed copper-joints, *without turning*, I cannot, with common courtesy, refuse to do so; I beg therefore to say, that if the casting be moderately true, instead of bringing the iron surfaces *to within somewhat less than half a sixteenth of an inch of being in contact*, let Mr. S. Y. and Mr. Gilman allow them to be as much farther asunder, as the unevenness of the surfaces require; for as the annealed copper-wires (which may be of the proper thickness) are to make the joints, the nice juxtaposition of the iron surfaces mentioned by Mr. Gilman is not necessary. But if the surfaces be not sufficiently accurate, let them be *roughly* turned instead of being *accurately* turned, and *nicely* faced.

If I should not run the risk of being again accused of making *illiberal remarks*, I should say that it appears to me that S. Y. has learnt of Mr. Gilman to give the text and withhold the context. He says, "the method of making the joints has been described, and although it was stated that the parts were *accurately faced*, that was merely *labour wasted*." Now he withholds Mr. Gilman's *reason why* "the ends of the cylinders were *accurately turned*, and the cover and bottom *nicely faced*;" viz. *to joint with the cylinders*; therefore, as the wires prevent their so jointing, this proves that it was not merely *labour wasted*, but that it was also (as I have before stated) *fudge*.

Mr. S. Y. observes, "as to A Practical Engineer knowing what bolts will do, he must be sadly ignorant if he did not, for it is a matter of most simple calculation." Now, Mr. Practical presents his respectful compliments to Mr. S. Y., and begs to inform him that it is not a matter of quite such *simple* calculation as he seems to imagine. Perhaps he thinks that to secure steam of 300lbs. on the square inch, the force with which the bolts press the cover and bottom into contact with Mr. Gilman's generator, need be only equal to 300lbs. per square inch on the area of the generator; but I can tell him that double, treble, and quadruple that pressure will not be sufficient. In return, therefore, for the information I have given him, how to do without *accurately turning and nicely facing the joints*, I hope he will favour me with his *simple* mode of calculating the needful strength of the bolts. In his account of the said bolts, I must observe *en passant*, there is some inconsistency, for he at one time implies that the aggregate thickness (or to use Mr. Gilman and S. Y.'s more scientific phraseology, the *aggregate sectional area*) of the bolts is sufficient to secure the steam; and at another time he implies that the bolts are larger than those shown in Mr. Gilman's drawing, for he says, that "we have no right to expect the drawing to exhibit the size of the bolts," and that the "sketch was never designed to give the measure of them."* As to the quotation of Mr. Horn's name, if it were not to prove the joints would not hold, S. Y. will perhaps tell us for what purpose that gentleman's name was introduced at all.

In answer to S. Y.'s queries, whether "A Practical Engineer really thinks Mr. Gilman's statement false, and only wishes to make the truth manifest?" I feel bound to answer both in the affirmative, and to say also that I have contented myself with putting a *fair* (or rather true) construction on that gentleman's statements, and I contend that not one single assertion which I have made, during the whole controversy, has been disproved or refuted, and that Mr. Gilman's narrative and drawings remain with their original imperfections on their backs; for all that has been done, is an attempt to apply a subsequent remedy to the defects which I have pointed out, and which are, therefore, tacitly admitted.

In conclusion, and in reply to S. Y.'s last query, whether the "end and aim of" my "lucubrations is to make Mr. Gilman appear an impostor, whether he is so or not?" I beg distinctly to answer in the negative, and leaving it to the tribunal of your readers to judge of all matters between us,

I am, Sir,
Yours respectfully,
A PRACTICAL ENGINEER.

April 14, 1828.

OPINIONS IN MANCHESTER ON THE GILMAN CONTROVERSY.

Sir,—As any improvement on the steam-engine is a most highly interesting subject to the mechanical world, I need scarcely inform you that the Gilman controversy has excited extreme interest in this large mechanical and manufacturing town, and that consequently the weekly arrival of the

* I suppose he had this information from Mr. Gilman himself; he certainly could not derive it from that gentleman's narrative and drawing or refutation. If I were to guess that the letters bearing the signatures of W. Gilman and S. Y. are the production of the same person, perhaps I might not be very wide of the mark.†

† Just as wide as possible.—ED. M. M.

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"Mechanics' Magazine" has been looked for with increased eagerness.

I beg to say (like S. Y.) "that without entering into the dispute between Mr. Gilman and his opponents," I feel in common with many others extremely disappointed at the unsatisfactory account Mr. Gilman has at present given of his generator, which at the onset promised so much, and of which, in consequence of some of his positive statements, I think he ought to give the public a much more satisfactory account than he has hitherto done.

As Mr. Gilman did not offer his generator to your readers as a *proposed* apparatus, but as one actually put in practice, I cannot, notwithstanding the many apparent (and at present uncontradicted) inconsistencies in the case, suppose him capable of such extreme disingenuousness as attaches to him at present, from his not having satisfactorily *proved* the incorrectness of the charges of the person signing himself, "A Practical Engineer." And I beg to say, that if, on the one hand, the thing be a mere proposal or scheme of Mr. Gilman's, and not reduced (as stated by him) to practice, I think he ought to have the candour to avow as much; but if, on the other hand, he has actually put it in practice, and the charges of the "Practical Engineer" be incorrect, he ought at once to prove so, and satisfy the public by showing it in operation, either to yourself or some other respectable, disinterested, and competent person.

I must say that the reasoning of "S. Y. (an engineer)" does not seem of a judicious or impartial kind, when he says, "I do not remember that it was any where stated, that the drawing of the generator was an *exact* one, or *to a scale*. For my own part, I took it for a rough sketch, for the purpose of explaining the *principle* proceeded upon, and *nothing more;* and this being the case, we have no right to expect the drawing to exhibit the mode of making the joints, or the size of the bolts." Now, surely, if the drawing were made from an apparatus actually in existence, it would be both an *exact* one and *to a scale*, for no scientific man would make a drawing without doing it *exactly and to a scale*. And as to its being merely "a rough sketch, and nothing more," Mr. Gilman has explicitly stated the contrary. We, therefore, certainly "*have* a right to expect the drawing to exhibit the mode of making the joints, and the size of the bolts." Although I wish to avoid entering into the dispute, I cannot but give it as my opinion, that surfaces *accurately turned and nicely faced, to joint with the cylinders*, were certainly meant to come in contact, and not to be separated by a copper-wire. I do not think Mr. Gilman will thank S. Y. for saying, "the fact is acknowledged by Mr. Gilman" that the joints were not tight, &c.; for if he admits that, it proves that the "Practical Engineer" is correct in saying that the apparatus was never put in operation: the truth of which assertion I understand to be the great point in dispute.

S. Y. has put the question respecting Mr. Gilman in so coarse a point of view, that I am at a loss to guess whether he be a pretended friend or a concealed enemy. Certainly Mr. Gilman does not deserve the strong appellation of *an impostor*, even if he have been exercising a little with the *long bow;* and as I would do even-handed justice to both parties, I must also give it as my opinion, that although "A Practical Engineer" has perhaps used too severe language, it cannot be denied that his epistles *tend to making the thing manifest, and to putting a fair construction* on that gentleman's (Mr. Gilman) statements. Waiting for further information upon this interesting subject,

I am, Sir,

Yours, &c.

PETER PINDAR.

Manchester, April 15, 1830.

RULE FOR CALCULATING MEAN SPECIFIC GRAVITIES.

Sir,—The following rule for the above purpose is given by Dr. Ure, in his "Dictionary of Chemistry," (see that work, articles *Alloy*, *Ammonia*, *Specific Gravity*.)

The arithmetical mean is so generally considered the correct calculated mean specific gravity, that the correct rule cannot be too widely circulated.

The mean specific gravity of two bodies is found by dividing the sum of the weights by the sum of the volumes.

W w = the two weights.
V v = . . volumes.
P p = . . specific gravities.
M = the calculated mean specific gravity. Then $M = \frac{W+w}{v+v}$.

The false, or arithmetical mean specific gravity, is represented by $\frac{1}{2}\left(\frac{W}{v}+\frac{w}{v}\right)$.

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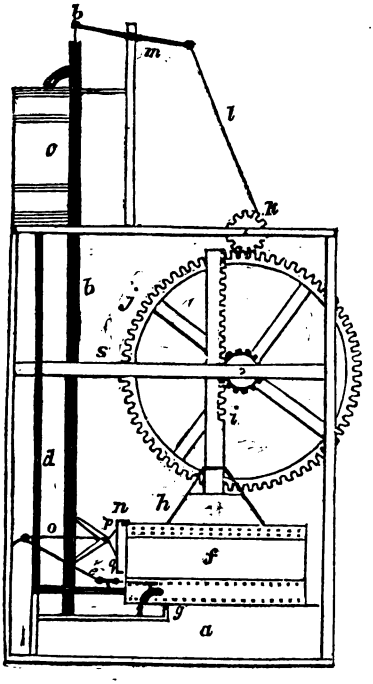
P p being the specific gravities of the two components, we have $P = \frac{W}{V}$, and $p = \frac{w}{v}$; whence $V = \frac{W}{P}$, $v = \frac{w}{p}$.

Example.—Given 12 ounces of a body of the specific gravity of 4·5, and 15 ounces of the specific gravity of 2·4. Here $\frac{w}{p}$ or $\frac{12}{4·5} = 2·66$, and $\frac{w}{p}$ or $\frac{15}{24} = 6·25$. And $\frac{W+w}{V+v}$ or $\frac{12+15}{2·66+6·25} = \frac{27}{8·81} = 3·064$, the true mean specific gravity; $\frac{1}{2}$ (P+p) or $\frac{1}{2}\left(\frac{W}{V}+\frac{w}{v}\right) = 3·3$, the arithmetical or false mean specific gravity, and which in every case is greater than the true.

I am, Sir,
Yours, &c.
H. Hopwood.

London, April 9, 1830.

AN EXERCISE FOR PERPETUAL-MOTION SEEKERS.



Sir,—Let us suppose an apparatus to be constructed of the description represented in the prefixed engraving; *a* is a water cistern, whence water is to be raised by the pump *b*, to supply the cistern; *c*, *d*, is a small pipe with a stop-cock at *e*, which lets the water from cistern *c* into a strong water-tight bellows *f*. The bellows have no valve, but a cock *g* to let out the water into cistern *a*: *h* is a weight, and *i* a rack on the top of the bellows which works in the cogs on the axle of the large cog-wheel *j*; *j* turns the little cog-wheel *k*, that gives motion to the arm *l*, and works the pump-handle *m*; *n* is an upright rod on the end of the lever *o*, which rod has a turn at *p* and *q* for the top of the bellows to press against in ascending and descending. The water being let into the bellows from the pipe *d*, will cause the top of the bellows, with the weight and rack, to ascend till the former reaches and presses *p*, which will move the lever *o* and the arm or rod *r*; by which means the stop-cock *e* of the pipe will be shut, and the cock *g* opened, and the water let in from the bellows into the cistern *a*. The top of the bellows will now descend till it comes down and presses the turn *q*, which will again shut the cock *g* and open *e*, on which the water will again flow from the pipe into the bellows, and cause the top with the rack to ascend.

Now it is generally known that the power of an hydrostatic bellows is thus calculated.

As the area of the orifice or section of the pipe,

To the area of the bellows:

The weight of water in the pipe is,

To the weight the bellows will sustain on the top-board.

We will suppose, therefore, the pipe *d* to be 10 feet high, with a bore equal to 1 square inch, which would give 120 cubic inches, and about 4¼lbs. of water. Let us suppose, also, the boards of the bellows to be 20 inches square, which gives 400 square inches. When the water is let from the pipe into the bellows, there will be a pressure of 4¼lbs. on every square inch, which on the whole will amount to 1700lbs. Now take half of this force and place it on the top of the bellows; there will then be a working power of

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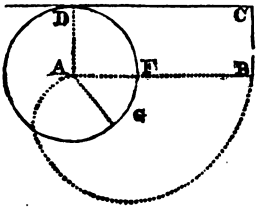
850lbs. up and down, and allowing the bellows to raise one foot, it will contain about 20 gallons of water. Now the question is, will not the machinery, with a moving power of 2 feet and 850lbs., raise 20 gallons of water 10 feet, which would, of course, cause the motion to be perpetual?

JOHN SIMS.

Pwllheli, North Wales,
Dec. 11, 1829.

METHOD OF DESCRIBING THE WATCH-MAKER'S SNAIL.

Sir,—It is partly in answer to the inquiry of your correspondent, "Indicator," vol. vi. p. 167, for a method of describing the "watchmaker's snail," and partly on account of the remark of "F," vol. x. p. 74, that Clairaut had proved by seeking its equation that the involute of the circle "became changed into the spiral of Archimedes when the describing point is in the very centre of the base circle"—that I am induced to send to you the following trifle. Now, "Indicator's" method of drawing the "watchmaker's snail" is nothing more or less than an approximation to the above-mentioned spiral; on the assumption, therefore, that this is the curve he requires, I shall, without going into any investigation for the equation, prove the truth of "F.'s" remark in the following manner:—



The spiral of Archimedes is supposed to be generated by a point B moving equably along the straight line AB, which has an uniform angular motion round A. Now, let a straight ruler DC be rolled along the circumference of any circle DFG; then any point in the edge of that ruler, as C, would describe the involute. Set off CB perpendicular to DC, and equal to DA, the radius of the base; join AB: since DA is perpendicular to DC, we have AB equal and parallel to DC=(by supposition) to the arc DFG; also the angular motion of DA (and consequently of AB, since $\angle DAF$ is constant) is measured by the arc DFG. $\therefore AB + \angle DAG$; consequently, the curve described by the point B is the spiral of Archimedes. The distance AB between two entire revolutions of the curve is equal to the circumference of the circle; if that be too great, the remedy is to diminish the circle: but I think some of your ingenious correspondents could easily construct it in such a manner, that CB should move along AB or DC, so that AB would increase only one-half or quarter as fast as it now does. Trusting that this may be serviceable to "Indicator,"

I am, Sir,
Yours, &c.
R. C. Jun.

THE LONDON MECHANICS' INSTITUTION.

Sir,—I am sorry to have to acquaint you that the committee have refused compliance with the numerously signed requisition for a general meeting, to take into consideration "the apparent connexion between this institution and radicalism and infidelity;" not only so, but that they have, in the very teeth of it, since let the theatre to Mr. Robert Owen, for the purpose of delivering *Sabbath* morning lectures on the absurdity of that religion, of which the *Sabbath* is one of the most blessed fruits. What was before only suspected is now proved, past all doubt; the connexion is not apparent merely, but real and undisguised. I wonder what we shall have next—Sabbath *evening* lectures, I suppose, from that trader in blasphemy, Richard Carlile, or his frothy mouth-piece, Robert Taylor. A worthy old gentleman, who was long a sort of fixture of our reading-room, and at one time a member of the committee, used to say, jocularly, that he feared he was the only *Christian* who had any thing to do with the management of the institution. I begin now to think he was not far wrong, and that in losing him we must have lost our only Christian

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watchman. No committee of Christians could have so disgraced themselves as our present committee have done; nor were there a single Christian among them, would he remain a day longer the associate of men who have thus proclaimed themselves the patrons of the wildest infidelity.

I am, Sir,
Yours, &c.
HENRY SIMPSON.

April 11, 1830.

P.S.—There is a talk of having a general meeting in spite of the committee; but of what use are meetings after the length matters have now gone? The institution is already disgraced and ruined beyond redemption.

[We insert Mr. Simpson's letter, for though evidently written in a passion, and most likely, therefore, in a vein of exaggeration, it is of grave import. It will readily be admitted on all hands, that neither religion nor politics falls within the range of objects for the sake of which the Mechanics' Institution was established; and that in proportion as its proceedings take either a religious or a political cast, its usefulness must be diminished, and its permanency endangered. Were it therefore true, as our correspondent alleges, that the managers of the institution have chosen to identify themselves with the parties respectively characterized by the titles of "radicals" and "infidels," no terms of reproach which the English language affords, could adequately designate the profligate breach of duty of which they have been guilty. We say this without any reference to the merits of these parties; for, as regards this question of fraternization, all parties are alike—the managers have no business to mix themselves up with political parties at all. But what are the proofs on which Mr. Simpson rests his denunciation of the managers as disciples of "radicalism and infidelity?" Simply these—that the managers have let the use of the theatre to Mr. Owen, and *may perhaps* let it to Mr. Carlile or Mr. Taylor, as they have before let it to Mr. Cobbett and Mr. Hunt. Now Mr. Simpson can scarcely be ignorant of the fact, that the managers of the institution have again and again cautioned the public, not to suppose that they identify themselves in the remotest degree with the opinions or objects of the different parties who may hire from them the use of the theatre for debating or lecturing. While this protestation, therefore, remains unrecalled, no one has a right to found any inference injurious to the personal reputation of the managers, on the character of any of the parties to whom the theatre may happen to be let; and Mr. Simpson owes them an apology for speaking of them personally in the manner he has done in the preceding letter. But though there is no proof that the managers deserve the appellations which Mr. Simpson has bestowed upon them, we think he has good reason to be startled at the lengths to which their system of neutrality is carrying them. However well the rule of letting the theatre to any person who may choose to pay for it, may look in theory, it appears to us to be practically as pernicious a one as could be adopted. In the *first* place, the rule to be good for anything, as a shield from responsibility, must be adhered to in all cases, and at all hazards. The managers cannot grant the theatre to one party and refuse it to another—be his principles or designs what they may—without letting in a principle of distinction, which would at once put an end to their case of neutrality. Mr. Simpson says, he should not wonder if the Sabbath *morning* lectures of Mr. Owen were to be followed by Sabbath *evening* lectures from Mr. Carlile or Mr. Taylor. But if Mr. Carlile or Mr. Taylor should choose to pay for the use of the theatre on the Sabbath evenings (payment being the only recognised criterion), what reason could the managers give for refusing it to them which would not apply just as well to Mr. Owen? In the *second* place, the rule is one for an adherence to which the managers are not likely ever to receive due credit from the world; they may draw distinctions as they please, the multitude will not attend to or appreciate them. It is certain that in spite of all the disclamations of its managers, the London Mechanics' Institution has become, on account of the description of meetings held at it, identified all over the kingdom, as the head-quarters of the Cobbettites, Huntites, and other church and state tinkers of the day. We met with proofs of this every where, in the course of an extensive tour, which we made lately through the north-west of England; and have had letters from almost every quarter of the country, lamenting how woefully the institution seems to

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have been diverted from its genuine uses, to the purposes of schism and faction. Perhaps this impression would not have been so strong or so general if the political parties, who have had the use of the theatre, had been a little more honest; for it has been very observable of all the advertisements of their meetings, that they have been purposely so worded, that persons who look only at the surface of things (that is at least nine in ten) might suppose them to be emanations from the mechanics of London, as aggregated in the London Mechanics' Institution. Even Mr. Owen, of whose habitual integrity and fairness we have the very highest opinion, has not been wholly free from this sort of indirect deception. In a letter, which appeared from him the other day, in *The Times*, there was the following expression:—"In preparing my lecture for Sunday, *at the Mechanics' Institute.*" Mr. Owen will not deny that these words are calculated to convey to the million an idea that these Sunday lectures of his take place by *the appointment* of the *Mechanics' Institute*, and form part of the course of instruction provided at that place for the mechanics of the metropolis. But will Mr. Owen directly affirm as much? And if he cannot, is he not as guilty as others of fighting under false colours? Seeing then that the managers of the institution have gained, by the rule in question, nothing but injury to their reputation, and are likely, by adhering to it, to be dragged through still deeper sloughs of infamy, it may well excite surprise, that they should not, long ere now, have abandoned it for a discreeter system. The best apology they have to offer for their conduct, is but that of the poison-selling apothecary—their "poverty, and not their will, consents." The institution is so burthened with debt—the very interest of that debt amounts to so large a sum, that they are content to raise a revenue *any how*—to let the theatre to *any one* who can scrape together the means of paying for it. But why is the institution so deep in debt? Why is it reduced to such desperate shifts? And is there no better way of redeeming its fallen fortunes than converting what was meant to be a temple of science into a place of refuge for charlatans and demagogues? To answer these questions at large, would be only to repeat what we have said frequently before, with respect to the causes that have led to the sudden decline of this institution, and the means by which it may best be saved from destruction. The institution has not been plunged in debt without due warning of the perilous consequences being given; that theatre, which has involved it in so many spurious connexions, was not built with Dr. Birkbeck's money, till after the members were well apprized of the folly of building on any other foundation than means of their own acquiring; nor has there been wanting a friend to admonish them (though "more in sorrow than in anger"), that while they persist in hoping more from borrowing, and begging, and theatre-letting, than from following out with earnestness and energy the scientific purposes for which the institution was founded, restoration to independence and respectability is impossible.—Ed. M. M.]

VIBRATION OF MUSICAL STRINGS.

Mr. Editor,—In No. 252 of your valuable miscellany, I gave an illustration of the theory of the vibration of musical strings. I had drawn my information from such respectable sources, that I was much surprised to find an imputation of error by your correspondent, A. M—k, in No. 301, and for his information I send you some further observations on the subject. Dr. Young, in his "inquiry into the principal phenomena of sounds," says, "the phenomena of the Eolian Lyre may be accounted for on principles analogous to those by which the sympathetic tones* are explained:" he then goes on to show the cause of *several* sounds being produced by *one string* in vibration, which, as the book is scarce and valuable, I have compressed as follows:—

The particles of air which strike against the middle of an extended string will move the whole string from its rectilinear position, and as no blast continues of exactly the same strength for any considerable length of time, although it be able to agitate the string, yet unless it be of sufficient strength to keep it bent, the elasticity will cause it to return and by its acquired velocity to continue to

* See Harmonic Sounds, Rosseau's Dict. of Music.

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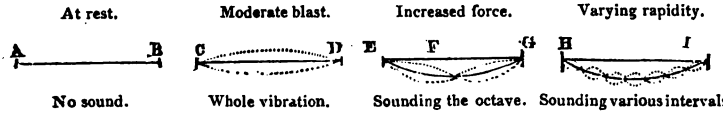
vibrate, exciting pulses in the air which will cause tone, differing in gravity or acuteness, according to the length and tension of the string. But if the current of air be too strong to allow the string to return, but cause it to remain bent, "strained like the cordage of a ship in a gale," yet though the whole string cannot perform its vibrations, the subordinate aliquot parts may, and it will divide itself into different vibrating lengths according to the strength or rapidity of the blast, or other exciting cause; thus—



From whence results—

1st. When the blast rises or falls we find the tone also rise or fall, because, as the string is tight strained, the shorter aliquot divisions will ensue; and as the strain decreases, the elasticity of the string will cause it to return, and the divisions will unite into one vibration of the whole string.

2nd. Sudden variations in the air will produce sudden transitions in the tones.

3rd. Simultaneous sounds will sometimes be heard, but observation will prove that they generally consist of such notes as are produced by *nearly equal* aliquot divisions of the whole string; thus, say C and E produced by $\frac{1}{4}$ and $\frac{1}{5}$, F and A by $\frac{1}{4}$ and $\frac{1}{5}$, A C E by $\frac{1}{5}$ $\frac{1}{6}$ $\frac{1}{7}$, &c.

4th. In long strings we never hear the original note and its octave, because, though they are the nearest aliquot parts ($\frac{1}{2}$ $\frac{1}{2}$), yet their difference of length is so great, that the blast which admits of the vibration of one obstructs the other, and it is therefore only in the higher divisions that simultaneous sounds are heard.

5th. Tones are *often heard* which *are not* produced by any exact submultiple of the strings; *these*, however, are always *transitory*, gradually rising or falling to the next, above or below, which *are* produced by an exact submultiple: this proves that the nodes or points at rest vary gradually with the vibratory cause, and were it not for this fact, the whole theory would be difficult of demonstration. That such nodes exist in a string in vibration, is capable of ocular demonstration by the ingenious experiment of Sauveur, who placed pieces of different coloured paper on the aliquot divisions of a string, which, when subjected to a trifling obstacle so as to divide it into parts without retarding the vibration, the papers on the points at rest remained, the others fell off.

6th. I refer your correspondent to an experiment easily performed.—Raise the dampers of a piano; strike any note, say C, and immediately damp it; and he will hear all those notes of the instrument whose strings bear any proportion to the percussed, sensibly vibrating, and which may be damped in succession, leaving any part of the chord sounding alone.

I am, Sir,
Yours, &c.
G. J. G.

Rugby, March 2, 1830.

MOFFAT'S METALLIC PINS FOR THE SHACKLES OF CHAIN-CABLES.

Sir,—The following remarks are intended for nautical men who may not yet be acquainted with the superior advantages to be derived from the use of Moffat's Patent Metallic Pins, for the Shackles of Chain-cables:—These pins are intended to obviate the difficulty which has always been experienced in extracting the iron pins, commonly used as forelocks in the shackles, ever since the first introduction of chain-cables. The patent metallic pin *will neither rust nor otherwise corrode:* by which advantage, should it be necessary to slip the cable at any time in case of emergency, the same can be effected in much less time than a rope-cable can be cut with an axe; even in a moment, by only striking a punch on the small end of the pin with a smart blow from a carpenter's common hammer. Consequently all the chain,

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but the working part, will be saved instead of its being allowed to run out to an end; and thereby not only doing great damage to the windlass, but endangering the ship and crew, which is frequently the case.

The metallic pins are of various sizes, according to the weight of the chain, and are introduced into the hole of the shackle in the usual way; previous to which the small end of the hole is countersunk (which may be done by the carpenter of the ship with a cold chisel). The pin is then driven in with a maul with any force, at pleasure, and the small end of the pin is then rivetted in the countersunk hole. At any period, however remote, it may easily be removed, by placing the punch on the rivetted end, and with one smart blow from a carpenter's hammer it will be instantly driven out. The uncommon ease with which this is effected, must convince every one of the superior advantage these pins possess over the iron pins now in use; as it is well known to nautical men, that on any ordinary occasion when they are required to be drawn, it is attended not only with great difficulty, but a consequent loss of time. Many instances might be adduced, where it has been absolutely necessary to employ a forge for the purpose, either on board the ship or on shore, at a considerable expense.

It thus appears that by using the metallic pins, a chain-cable, however large, may be as easily unshackled as the casting off the shank-painter for the purpose of letting go the anchor or a rope from a belaying-pin.

S. J.

FIRE-PROOF HOUSES—DUTY ON BRICKS.

Sir,—I feel much obliged to you for your prompt answer to my inquiry respecting Mr. Hartley's method of securing buildings and ships from fire. If, indeed, the partitions of a house are of brick, and there are no battenings, backlinings, boxings of shutters, soffits, skirtings, or any other *matchwood* work—especially such as extend from one floor to another—then I should suppose Mr. H.'s plan applied to the underside of the joists —that is forming a plate iron ceiling— would in the event of fire, so retard its progress, as to give sufficient time for any individuals in an upper floor of an ordinary house to escape with safety; and it would also protect brestsummers, whether of wood or cast iron. But has there not been some, perhaps imaginary, practical difficulty, or has it been a pecuniary one, which has prevented the general adoption of Mr. Hartley's plan?

I have more than once alluded to the utility of taking off the duty on bricks, and I have pointed out some of the advantages which would result from such a measure. It is not supposed that it would occasion an unnecessary quantity of buildings to be erected. The effect, it is anticipated, would be the construction of more substantial dwellings, and an inducement to pull down many an old house, and build a better one on its site. In short, nothing could be better adapted to facilitate the removal of every pestilential neighbourhood, and the formation of new lines of streets, both for convenience and health, in this metropolis. The fact, that a vast number of houses contain one, two, or more families in every room, must prove that there is no superabundance of habitations at present.

The benevolent desire of bettering the condition of the poor would be materially advanced by the removal of the duty on bricks. In colonization *at home*, which I am glad to see Mr. W. Horton has turned his attention to, the advantages will be manifest. Perhaps there is not a village or hamlet in the kingdom, which might not be benefited by the repeal; indeed, if that were done, there would then, perhaps, be no occasion for *compressing* earth into blocks, for cottage and field walls, or any other method at present, for the purpose of evading the duty.

C. D. S.

INSTRUCTIONS FOR LACKERING AND RE-LACKERING BRASS.

Sir,—In your 316th number, an Old Subscriber wishes to know the best method of lackering and re-lackering brass ornaments. I have conversed with several experienced mechanics and artisans in this place on the subject, who concur in stating, that on first setting out, they have had considerable trouble in finding out the best process, there being as yet nothing satisfactory to be found in books on the subject. I have, therefore, collected all the particulars of the

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process for the information of your correspondent and readers.

Old brass-work that is much pitted must be turned again in the lathe. When it is black and greasy, such as a drawer handle, it should be put into a boiling solution of common soda or potash, with a small lump of quick lime, then taken out, and after being washed in water, dipped into a pickle until it is clean; which pickle is made by adding 1lb. of the best nitric acid to ½lb. of sulphuric acid, and diluting the mixture with water till on putting a piece of brass into the mixture it will turn white without any bubbling or effervescence. Greasy brass-work put into this pickle would be only partially acted upon, if not previously put into the first solution. When your brass is clean, wash it in two different waters, roll it in saw-dust till dry, brush the saw-dust off, and burnish with a steel burnisher and ale-grounds or small beer. Then throw it into water till you are ready for lackering; but observe that it ought to be lackered as soon as possible, because the air soon tarnishes it. The brass-work should be heated to about 212 degrees. The lackering-cup should have a thin brass wire fastened over the top to stroke your brush on, that there may not be too much lacker in it; when there is an excess of lacker, the heat thins, and spreads it on the surface; it dries in lumps, and is not uniform.

For the lacker.—Take twenty ounces of alcohol, 1¼ dram of turmeric-root in powder, and 2 grains of hay-saffron, put them together and let them stand 24 hours in a warm place; pour off the clear tincture, and add gamboge ¼ ounce, gum juniper ½ ounce, gum mastic ½ ounce, seed lac ¼ ounce, powdered glass 4 ounces (the glass serves to separate the gums), till they are dissolved. Shake them well together every day till dissolved, then add 3 drams of dragon's-blood. The lacker will then be of a deep yellow, such as is used for philosophical instruments.

Take 32 ounces of oil of turpentine, infuse in separate portions of it, 4 ounces of gamboge, 4 ounces of dragon's-blood, and 1 ounce of anatto, and let them stand in a warm place till the solutions are completed. By adding a little of one or other of these three solutions to your lacker in the cup, you may have it of any tone of colour required, from the lightest straw to a deep gold colour.

I am, Sir,
Yours, &c.
Leeds, February, 1830. B. S.

MINOR CORRESPONDENCE.

Thorold's Locomotive-Carriage.—"I think Mr. Thorold has overlooked in his plan for the curvilinear railway, that the wheels on both sides of his engine make the same number of revolutions in the same time. Would not this defect (as I conceive it to be) prejudice the motion? Two cylinders would perhaps obviate it."

A. Z.

"I beg to suggest an improvement on this carriage. I suppose the piston-rods are connected by a lever or working-beam. Now, I think it would be much better if the projecting-arms were attached to the *lever*, instead of the *piston-rods*, as in Mr. Thorold's sketch, vol. xiii. p. 33."—J. J. Cole.

New Planets.—An esteemed correspondent reminds us that for general, and even nautical purposes, we need not have recourse to "Encke's Ephemeris" to supply the deficiencies of the "Nautical Almanac" with regard to the new planets, Pallas and Ceres. He adds: "There is a regular ephemeris of them in 'White's Ephemeris' for every 6th day in the year, and, indeed, for *every* day near their respective oppositions. You will also find that even the renowned astrologer, Francis Moore, gives the southing and declination of each of these four interesting bodies, for five days near their respective oppositions, and specifies the fixed stars which they will then be near. For example, he states, that on April 26th, Pallas will be nearly in a line with the three stars on the left leg of Boötes; and that on April 30th, Ceres in opposition will be 'about 3° east of the star μ, on the right foot of Virgo, and very near that marked 16 Libræ.' The correspondent to *The Times* should have specified that the right ascensions and declinations of Ceres and Pallas in 'Encke,' are for the *midnights*, not the noons of the respective days."

Omicron's Question.—Sir, on perusing your last Number (347), I perceive there is a misconception respecting the question proposed by me in No. 329; the Editor and some of his readers supposing that the numbers were all integral ones. That certainly was not my intention; and I find on referring to the question as printed, that the decimal points are clearly manifest. Indeed, it was the result coming out an integer under such circumstances, as Mr. Utting rightly intimates, that made the question interesting.—I remain, Sir, &c.

April 7, 1830. Omicron.

[The proposer of the question must, of course, know best what he meant, but he cannot be aware of the distinction between the use of the comma and the point in numerical notation, when he asserts that "the decimals are clearly manifest;" the comma being the character used in the stating of the question, and that always denoting that the numbers are integral. We cannot, besides, see what there is surprising in the result "coming out an integer under such circumstances." There is surely nothing uncommon in the sum of two numbers—each consisting of the same number of decimal places—being an integral number; or in a decimal number being multiplied by an integral one so as to produce an integral result. Nor do we see any thing in the remarks which Mr. Utting makes on Omicron's question which would not be equally applicable, whether the given numbers were all integers, or partly consisted of whole numbers and decimals.—Ed. M. M.]

Nutt's Bee-Hive.—"Mr. Massingbird's flattering description of Mr. Nutt's Bee-Hives, in a late Number of the "Mechanics' Magazine," and the great superiority he says they possess over the common management, have caused a

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few of us in this part of the kingdom to wish to keep bees on the new plan; and we will thank any of your correspondents if they will furnish us, through your highly valuable Magazine, with such a description of the construction of the hive and method of management, as will enable a plain, common-sense sort of a man to reap all the advantages which Mr. Massingbird holds out. If all be true that he says, I think I and my family would receive great help from it. I have asked a bookseller if Mr. Nutt has written a book about his bee-hive, and he does not think he has; and Moulton Chapel is in such an out of the way place, there is no getting there; I would not have minded 30 or 40 miles, but 150 or 200 is too far."

A HAMPSHIRE MECHANIC.

Mr. Thirlwall's Plan for dispensing with the Air-Pump in the Condensing Steam-Engine.—"If I understand this plan rightly, it is proposed to employ for the condenser, a cylinder of water exceeding 33 feet in length placed in an upright position, closed at the top and open at the bottom; which may be either immersed in water, or turned up to prevent the ascent of air. The water it is supposed will preponderate until it arrives at about 32 or 33 feet from the surface, and remain suspended like the mercury in a barometer; but as water contains air which is always given out by boiling or by removing the pressure of the atmosphere, this could not be the case. The water in the upper part of the cylinder being a little above the common temperature, would more easily disengage its air, which with the air set at liberty from the water in the boiler, would soon displace the whole of the water in the cylinder by occupying its place."—T. T.

HISTORICAL NOTICES OF INVENTIONS AND DISCOVERIES.

The Automaton Chess-Player.—Baron Von Kempelen, the inventor of this *androides*, was a native of Presburg, in Hungary, and a Member of the Aulic Council of the German Empire. He was a man of considerable attainments, not only as a mechanician, but in general literature. The determination to make this machine originated in the surprise excited in the Court of the Empress Maria Theresa by the performances of an eminent juggler. Von Kempelen had been invited to Court to witness this exhibition; and after the performance, declared that he would produce something which would surpass any thing they had seen, and in due time he completed his chess-player. In 1769, it was exhibited in various parts of Germany; it was afterwards taken to Paris; and in 1783, was first shown in London. After a tour through England, Kempelen ceased exhibiting his figure. It has been stated that his reason for this was, that being a man of fortune and station, he was unwilling to continue in this business. Another reason, however, was given by the late Mrs. Rivardi to a gentleman well known in this city (Philadelphia). She stated that she was well acquainted with Kempelen and his family; that his daughter, a girl of twelve years of age, and an excellent chess-player, was his coadjutor; and that her health declining from the confinement (within the machine) to which she was subjected, it became necessary to stop the exhibition. Von Kempelen, who has now been dead above twenty years, repeatedly offered his machine to M. Maelzel, (by whom the exhibition of it has been lately revived), but demanded 20,000 francs for it, which was thought too much, and the bargain was consequently not made. About two years after the death of Kempelen, his son renewed the offer, and proposed to take one half of the sum demanded by his father, to which M. Maelzel agreed, and the figure was removed from the garret where it had lain for about twenty years.—Dr. JONES, *Franklin Journal*. The accouut given by Mrs. Rivardi confirms the conclusion come to by all the writers who have ever treated of this extraordinary piece of mechanism, namely, that the moves must be made by some person concealed within it, through the intervention of machinery operating on the principle of the pentagraph. The latest and most satisfactory dissertation on the subject was one published in London in 1820, entitled "An Attempt to Analyze the Automaton Chess-Player of M. de Kempelen." It was accompanied by a plate, which showed very clearly the possibility of concealing even a full-grown man within the chest or commode behind which the figure is seated. A notice of this pamphlet will be found in the *Edinburgh Philosophical Journal* for April, 1821.

Astronomical Clocks.—The first instance of a clock with weights being employed for astronomical purposes occurs in 1484, when Walther states, that with a well-regulated clock he made an observation on Mercury.

INTERIM NOTICES.

We shall take an early opportunity of furnishing the information desired by Mr. Asplen and friends.

"Amator Scientiæ" (Secundus) should state more specifically his objections to the "Plan of an Harmonicon."

J. G. asks "whether the Society of Civil Engineers publish their Transactions?" They do not, and it is a pity. The Transactions of such a Society must be of the first importance.

We recognise with great pleasure the handwriting of "An Old Subscriber;" but regret that he should press upon us to insert a letter so merely critical as that which he has sent us. It conveys no information, and treats with uncalled-for severity a communication from one of our most useful correspondents. We have, in all conscience, enough of controversy already.

Mr. Harrison's letter of the 19th of March, and the accompanying model, have been received.

We have just received (Friday, April 23), from "Homo," who favoured us with the valuable process for brewing ale from mangel-wurzel, given in our 332d Number, the account which he promised to send us of the mode of cultivating that plant "previous to the season for sowing," and shall give it a place next week. It may be of use to such persous as have been waiting for this account, to mention, in the meanwhile, that "Homo" states he has found from long experience that "about the 7th day of May is the most proper season for sowing." As several persons have since our publication of "Homo's" method of brewing ale from mangel-wurzel, put forth pretensions to the merit of this discovery, it may be as well, in order to prevent mistakes as to the identity of the real discoverer, to add, that "Homo" has now dropped this *nom de guerre*, and signs his present letter with his real name—"Edward Watson, Surgeon, Laceby, near Grimsby."

Communications received from S. Y.—J. J. C.—J. O. H.—T. M. B.—A Country Curate—G. S.—Mr. Sims—M. J. G.—Boyd Willock—Mr. William Butler.

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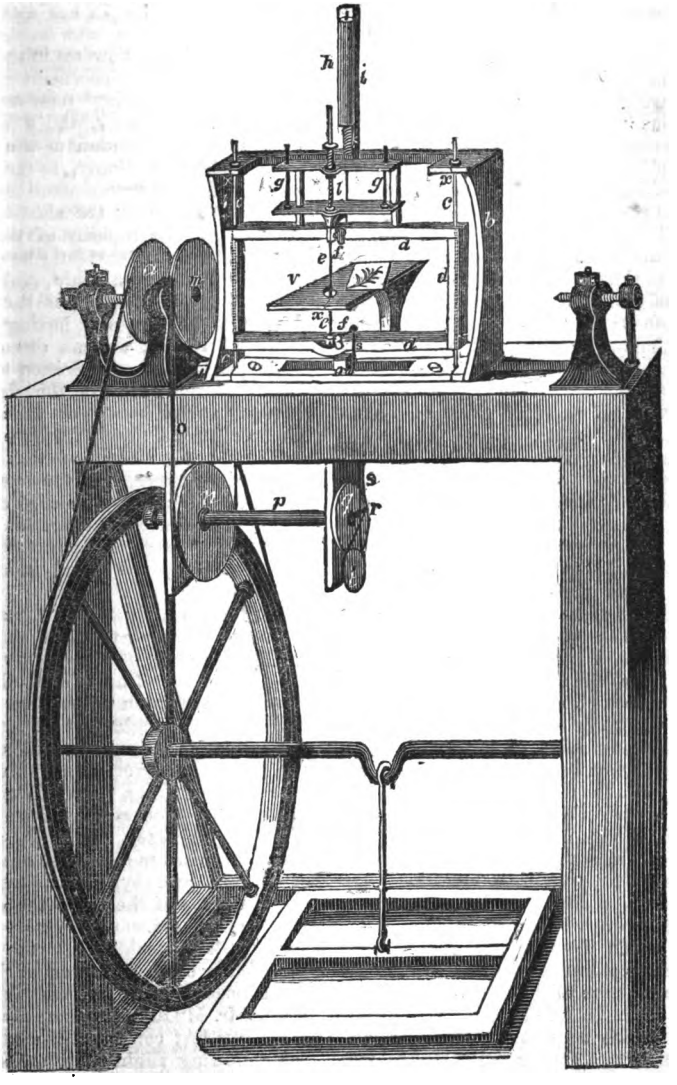
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 351.] SATURDAY, MAY 1, 1830. [Price 3d.

M'DUFF'S BUHL-CUTTING MACHINE.



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M'DUFF'S BUHL-CUTTING MACHINE.

In our report of the last anniversary of the London Mechanics' Institution (vol. xii. p. 275), it was stated that the prize of £10, granted by Dr. Fellowes for the best machine invented by a working member of the London Mechanics' Institution during the year 1829 (one of the few benefits resulting from the Institution), was awarded to a Mr. M'Duff, a working turner, for a buhl-cutting apparatus, of the superior capabilities of which some striking examples were given. Having since applied to the ingenious inventor for a more particular account of the apparatus, he has kindly enabled us to present our readers with the prefixed engraving, and the description subjoined.

The engraving exhibits the buhl-cutting contrivance as it is connected in working with a common lathe. It is of course only necessary to notice those parts of the joint apparatus which are peculiar to the present invention. A frame of wood *bb* is fixed to the bed of the lathe by two pins, or screws. Two guide-wires *cc* are fixed to this frame, and on these wires the reciprocating frame *ddd*, that carries a very fine and delicate vertical saw *e*, slides up and down. The saw is fastened at each end *ff* by the usual contrivance, attached to a frame-saw, and it is distended by the action of the set screw shown in the upper little frame *gg*. A hollow cylinder of wood *h* is suspended to the upright piece *i*. This cylinder contains a spiral wire spring *k* at the lower extremity, which is fixed to the back part of the frame at *l*, and thereby holds the reciprocating frame in suspension. It will now be evident, that when this frame is depressed by the application of a very slight degree of force, the saw *e* will make a downward cut, after which the elastic contraction of the spring will draw the frame and saw up again. We have, therefore, only to describe the mechanical means by which this motion is effected with great rapidity and uniformity, through the medium of the lathe. On a cheek of the lathe is fixed a common pulley *m*, which communicates the rotary motion to a similar pulley *n* beneath, by means of an endless cord *o*, which embraces them both; the spindle *p* thence communicates the motion to the wheel *q*, which has a pin *r* fixed centrically on its outer face, and to this pin is attached a cord *ss* which passes round the small pulley *t*, and thence is attached at *f* to the back of the lower part of the reciprocating frame *dd*. At *w* are brought into view the tenons and keys by which the lower appendages are attached to the lathe

The lathe being now set in motion, the rotation of the eccentric pin *r*, gives a reciprocating semi-rotative action to the pulley *t*, and a downward rectilineal motion to the cord line *s*, and, consequently, to the saw-frame, which, as before-mentioned, is carried up again by the elasticity of the spring. The rapidity of this action, of course, can obviously be easily varied. At *v* is a little table, on which the workman places the substances to be cut, and having both hands at liberty, he can direct the work with the utmost precision to the most elaborate parts of the design, without apprehension or difficulty. The saw passes through work of the ordinary kind almost without any sensible resistance, and the operator being, as it were, thus relieved of labour and anxiety, can exert his taste in executing work of far greater elegance than by the usual mode of proceeding.

In order to make the saw, as it is technically termed, that is to sharpen it when required, it is necessary that the sliding-saw frame *ddd* should come out and go in at pleasure; because the saw ought to be stretched while making or repairing it, and it will be more convenient for this purpose to place it in a vice. There are, accordingly, grooves *xxxx* made in front of the fixed frame to allow the guide-wires to come out with the saw-frame, and by unscrewing the nut at the top of the wires the whole will be liberated.

As it is desirable that the saw should move in a greater or lesser space according to the fineness of the work, Mr. M'Duff has since the machine was first constructed, contrived the following slight addition to accomplish that object. He proposes

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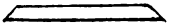
that the button-crank at the end of the spindle *p* should be fixed to a thin piece of wood or metal of a dove-tail shape, as thus,



and that a groove to receive it should be made in the face of the pulley. It will then slide out or in from the centre, and may be fixed by a flat-headed screw, or in any other way most convenient.

Although the chief purpose for which this very ingenious apparatus has been designed is the cutting of buhl-work, yet, as truly stated by the Committee who adjudged the prize to Mr. M'Duff, "it will do much more;" being equally applicable in all cases where a rectilineal reciprocating action of the straight-edged saw is required. It has already, we understand, been applied with excellent effect to the cutting out the wards of keys.

Mr. M'Duff informs us that he has "a still more simple method for those who may not have a lathe, which will be at our service in the course of two or three days." We shall be glad to receive it, and to lay it also before our readers. So much readiness on Mr. M'Duff's part to make the resources of his ingenuity subservient to the assistance of his brother-artisans, does him great honour.

METHOD OF CULTIVATING MANGEL-WURZEL.

Sir,—According to the promise I made when I sent the method of brewing ale from mangel-wurzel, for insertion in your valuable Magazine, I now send you some account of the method of cultivating the same. Many people imagine that early sowing the seed of the above plant is conducive to a large root—I grant that the *very few* plants which do not run to seed will produce large roots; but the proportion of the plants which do not run is so small, that a great loss is sustained by early sowing. From long experience, I find about the seventh day of May is the most proper season for sowing. I have cultivated it for more than twenty years, and have tried many experiments, the result of which is, that the following is the most proper mode of cultivation.

Let the ground be *well* dug to the depth of a foot, or even more, and all the lumps of earth well broken; the ground must be raked even after the spade, and as little trodden as possible; if some rotten dung be dug in, so much the better, as the land cannot be too rich and strong; draw *very shallow* trenches sixteen inches from each other, and from ten to twelve inches apart; in those trenches deposit two or three seed-pods, then cover them as lightly as possible with earth—for although the plants are strong when full grown, I do not know a plant whose seeds will bear less covering than mangel-wurzel.—After the plants have grown three or four inches out of the ground they may be thinned, so as to leave only one plant (and that the largest) in every ten or twelve inches. Should any of the seeds entirely fail, one of the strongest plants drawn out may be planted, being careful not to break the root in planting, as that would be certain to make a short and small root. The best way is to make a hole sufficiently deep with a dibble, to allow the plant to go down perfectly straight: those plants which have been drawn and replanted must be well watered for a few days. In about ten days or a fortnight after thinning the plants, they may be lightly moulded up, and the ground be henceforward kept very clean. In about two months the bottom leaves may be broken off, and given as food for pigs, which they are very fond of. The rent of ground and expense of labour are well repaid by the leaves alone, which may continue to be taken off, as they grow, until the latter end of October; when the plants must be taken up, the tops cut off, and given to pigs or cows, and the roots buried in the same manner as potatoes are. They are then either brewed into ale, or given to pigs or cows, as winter or spring food: they are better boiled and mashed as potatoes are; and with a small portion of barley meal, will fatten pigs exceedingly quick. It will be necessary in the spring, when potatoes are taken out of the graves, to take the roots of mangel-wurzel out also, and lay them in a dry building. I have frequently kept the old roots until after the Midsummer following, perfectly sound and good.

Since the very extended publication of my method of brewing ale from mangel-wurzel, I see others have published a method of brewing, as emanating from their own brains. Now Sir, as I am certain I was the first to make known the method of brewing such ale,

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I shall no longer appear as an anonymous writer, but subscribe myself with every good wish for the welfare of your Magazine.

Your sincere friend,
And obedient servant,
EDWARD WATSON.

Laceby, near Grimsby, April 16, 1830.

PROCEEDINGS OF THE SOCIETY FOR PREVENTING LOSS OF LIFE BY FIRE.

Sir,—The attempt of Mr. Hudson, in your 349th Number, to justify the proceedings of the Society for Preventing Loss of Life by Fire, compels me to offer a few words in reply.

Mr. Hudson, as the zealous founder and active secretary of this society, is entitled to the greatest respect; and although it was impossible to separate him from the proceedings of the society, yet I can assure him that it was with the greatest reluctance I introduced his name at page 69; and I now still farther regret that I am compelled to place myself in opposition to him. His last communication, however, leaves me no alternative—if I wish to preserve my character for veracity. With regard to the ingenious manner in which "my feelings" are represented as inimical to the success of the society, permit me to say, that I am closely engaged in an extensive mercantile concern (as perhaps you know) the whole of the day, and had not, therefore, the power to take any part in the proceedings of the society. Nevertheless, when Mr. Hudson's first proposal appeared in your Magazine, it occurred to me that I might perhaps render material assistance in carrying into effect the ultimate object of the society. Actuated by this feeling, I went to the "Public Exhibition of Models," for the express purpose of offering my services as a volunteer;* but to my great disappointment, neither then nor since has any plan been adopted, in which my assistance could be useful; and I still remain, to the present hour, "anxiously expecting the time, when I may have an opportunity afforded me, of personally assisting in the attainment of the society's praiseworthy object."

I am sorry to observe that Mr. Hudson is angry with me, and in attempting to patch up a hasty defence, has forgotten his usual candour; he says my description of Wild's machine "is altogether an exaggeration." I reply, to describe it correctly; is to ridicule it sufficiently; exaggeration is needless. But why did not Mr. Hudson point out in what the exaggeration consisted? And in what respect the machine differs from my description?

Mr. Hudson also denies the *alteration* which I stated to have been made in the machine. Does he ground his contradiction upon a logical quibble? Or are the *wheels*, upon which the machine *now runs*, the same as at first?

I should have been better pleased had Mr. Hudson given something more than mere *ipse dixit* contradictions; surrounded as he must be with facts, proving either the correctness or incorrectness of my "hearsay assertions."

With regard to the disposal of the funds, that is *perhaps* matter of opinion, and I would not have again mentioned that subject; but as your printer, by a change of punctuation, altered (or rather destroyed) the sense of my former paragraph, I repeat, "that the society have received donations from some of the Fire Insurance Companies, as well as from individuals; and have squandered away funds, amply sufficient, if properly applied, to have enabled them to commence and continue active operations, on an extended scale, for at least twelve months. After they had commenced operations, subscriptions would have been obtained in greater abundance, and might indeed have been solicited with a better grace than at present."

Since I last addressed you upon this subject, another calamitous fire has occurred; at which, although the most praiseworthy alacrity appears to have been displayed, there was barely sufficient time to fetch a ladder. Some few persons were saved by the ladders—some precipitated themselves from the windows previous to its arrival, and several made their escape at the top of the house; but SEVEN persons, of both sexes, and of various ages, perished in the ruins of the conflagration. Were I asked, which of all the various fire-escapes which have been suggested, would have enabled those present to have effected the rescue of all the inmates of this building? I would say, that no fire-escape of *any kind* would have done this; *unless it had been on the spot at the commencement of the fire: then*, any one which would have enabled those below, to go up and assist those who were unable to assist themselves, and to have brought them down in safety, would have answered the desired purpose. Either a common fire-ladder, or Wild's machine, would have done.

* See vol. ix. page 92.

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After this catastrophe, a public exhibition of fire-escapes took place (as usual). Among the rest was a very pretty one, by Mr. Merryweather, of which more hereafter; Wild's machine was also present. *The Times*, speaking of this machine, says, "the apparatus which attracted the greatest notice, and is likely to be the most useful, was a machine constructed upon the principle of the *fire-escape ladders*. It is as easily removed from place to place *as a fire-engine* (upon this occasion it was drawn by TWO HORSES!). And we have little doubt, that with a little practice in those who manage it, and a few improvements of which it is easily susceptible, it will be found of the utmost value in such cases of fire as have been recently witnessed in the metropolis."

In conclusion, although I grieve to see the Society for Preventing Loss of Life by Fire falling so very far short of the purpose for which they were established; I have no feelings of hostility towards them either collectively or individually; on the contrary, right happy shall I be to assist them whenever an opportunity for so doing usefully may offer.

I am, Sir,
Yours, &c.
W. BADDELEY, Jun.

April 24, 1830.

VINDICATION OF MR. SAMUEL HALL'S INVENTIONS FROM THE RIVAL PRETENSIONS OF MR. GILMAN.

Sir,—Although I have been much surprised at some parts of the correspondence between Mr. William Gilman and A Practical Engineer and others, I should not have taken the liberty of addressing you, did not Mr. Gilman, in spite of the many severe corrections he has received, still persist in pretending to lay claim to an invention, which it is quite clear he has taken from Mr. S. Hall.

Mr. Gilman's reply in your last week's Magazine to Mr. Syngleman, is a most indecent repetition of his pretended claims; so much so, that I feel it a duty I owe to Mr. Hall and the public to expose them.

Some time ago I was engaged in superintending the making and erecting of Mr. Samuel Hall's apparatus; and although I have been for some time residing at this place, and unconnected with him, I happen to be in possession of some information which may be interesting to your readers, and throw some light upon the subject; and as this dispute has excited much attention in this neighbourhood, I shall feel obliged by your giving this letter an early place in your Magazine.

In order to contrast the proceedings of Mr. Hall and the dates thereof with those of Mr. Gilman, I will arrange them side by side.

On April 8, 1824, Mr. Samuel Hall obtained a patent for an apparatus which was constructed for him early in that year by the Butterley Company, near Derby.

Early in 1825, Messrs. Weatherhead and Glover, iron-founders, and Mr. William Mosedale, engineer, both of Derby, constructed the first generator, and some other parts of the apparatus, as described in Mr. Hall's patent of May 31, 1828; and Mr. John Hague, engineer, No. 36, Wellclose-square, London, made (also in 1825) the working cylinder and some other parts of the engine, which was immediately got to work; continuing to receive various improvements till the patent was obtained, May 31, 1828.

Mr. Gilman says, that in 1826 he constructed his generator, as delineated in number 330 of the "Mechanics' Magazine," being too palpable an imitation of Mr. Hall's apparatus of 1824, to need any comment.

On December 5, 1829, Mr. Gilman has, in the face of Mr. Hall's patent of May 31, 1828, the modesty to bring forward an imitation of that gentleman's generator of 1824, as his own invention, ascribing to it pretended operations of which Mr. Hall's last patent apparatus alone is capable, and which cannot be effected either by his first generator, or Mr. Gilman's imitation thereof.

Of all the instances of plagiarism I ever met with, this is certainly the grossest; and such is the opinion of all the persons with whom I have conversed, who have read the controversy in your Magazine.

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Mr. Gilman acknowledges himself intimately acquainted with Mr. Hall's patent of April 8, 1824. Now, having availed himself of that patent so largely, can it for a moment be supposed that he has not obtained an equally complete knowledge of the subsequent one of May 31, 1828? Mr. G. shows, that in 1826 he had castings prepared for *Gilman's generator*, but he does not *then* show for what purpose it was intended, nor does he explain till December 5, 1829, viz. eighteen months after the date of Mr. Hall's last patent, whether it was designed to act upon the principle of that gentleman's first patent, for the decomposition of steam, or upon that of his last, for "the combustion of fuel in an artificial atmosphere, greatly superior in density, pressure, and elasticity to the natural atmosphere surrounding the earth, to produce motive power," &c.

Nothing can show more fully how little Mr. Gilman really knows of the principle and apparatus he has pretended to have discovered and invented, than his statement that the artificial atmosphere might be produced as beneficially (if not more so) by an exhausting, as by a forcing apparatus.—See "Mechanics' Magazine," number 345, page 39. "Allow me (he says), to say a word respecting what I have proposed in my narrative: properly speaking, Mr. Editor, there are three plans, or one plan, and *two* modifications; and it may be perceived by very little attention, that they emanate from the same system, and that it would be almost impossible for the mind to conceive either of those plans which are given as the *second* and *third*, or *last* modification: without the other, indeed, both these plans were projected, before any idea existed of applying the products of combustion more directly, as in the manner described by the drawings in the 330th number, and perhaps they are still the more valuable, particularly the last modification." Now, it must be evident, that by a forcing apparatus, you would obtain Mr. Hall's desideratum, viz. an artificial atmosphere of *increased* density and elasticity; whereas an exhausting apparatus must of necessity produce an artificial atmosphere of decreased density, &c.; and to such an atmosphere, I am sure, Mr. Hall would say Mr. Gilman is perfectly welcome. It is true, Messrs. Braithwaite and Ericsson may avail themselves of an exhausting apparatus with precisely the same effect as a compressing one, owing to their discharging the nitrogen and the gases resulting from combustion into the atmosphere, without causing them to act upon a piston, which is the object Mr. Hall has in view, and in which Mr. Gilman is vainly attempting to imitate him. I must now observe that the quotation I have just made proves that Mr. Gilman's object in making his generator was not, in the first instance (whatever he has tried to twist it to subsequently), intended to effect "combustion *under great pressure*, from 200lbs. to 300lbs. per inch." What can show this more clearly than the following part of that quotation—"indeed both these plans were projected before any idea existed of applying the products of combustion more directly, as in the manner described by the drawings in the 330th number."

Had I not extended my letter to an unreasonable length, I would have given you still more cogent arguments upon this part of the subject, which possibly may be drawn from me at a future time. In the interim,

I remain, Sir,

Yours respectfully,

WM. BUTLER.

Stockport, April 21, 1830.

MOMENTUM OF FALLING BODIES, &c.—CONTINUATION OF "S. Y.'s" REMARKS ON MR. HARRISON'S PAPERS.

Sir,—The words, "or to produce an equal effect in an opposite direction," page 85, are an interpolation of my own; but from a slight oversight of your printer, they appear as part of the quotation from Mr. Harrison's paper.

I will not stay to comment on the *motive*, the *feeling*, or the *taste*, which induced Mr. Harrison to parade in No. 309 of your work, the blunders contained in the specification of a fellow-tradesman. As those blunders had *not* appeared in your Magazine, it could not be for the sake of "refuting false principles." He is *obliged* to confess Mr. Wynn "has a better notion of connecting the hammer with the clock, than most others of the profession;" but *modestly* gives your readers to understand that he himself has a much better still.

I am quite aware that "action and re-action are equal, and in contrary directions," and so, I dare say, is Mr. Wynn. And I am also aware that it requires four springs to give double

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the velocity to the same body that one spring would give; that a cannon-ball moving with twice the velocity of another of the same weight and size, penetrates four times as deep into the same kind of homogeneous matter—that the effects of a ram upon a pile are nearly in the same ratio as the squares of the ram's velocity, &c. &c.: all which seem, "at first sight," to confirm Mr. Harrison's opinion of the momentum of bodies; but I shall reserve the explanation of these matters for another paper.

We now come to No. 343, page 4, where Mr. Harrison, after *falsely* accusing me of making a "false assertion," observes, that "*veracity* is *one* of the most essential qualifications of a critic;" and immediately gives your readers to understand that I accused him of saying, "a faggot of wood was equal to a flaming furnace." My words were, "Mr. Harrison *might as well* declare a faggot of wood, &c. &c.," as assert what he has: so much for Mr. Harrison's *veracity*. Sir I. Newton declared the momenta of bodies were as their velocities; and when Mr. Harrison says, "the momenta of bodies are as the *squares* of their velocities," I humbly conceive that he and Sir Issac differ in opinion, notwithstanding Mr. Harrison says they do not.

It is "*a false assertion*" that my paper contradicts itself. Nor did I commend Mr. Harrison for "controverting false principles," or for contradicting the false principles of other people, to substitute other false principles of his own. What I *commended* him for, was, his appearing to have some consciousness that "mere matters of dispute were unworthy the pages" of your work; and what I *blamed* him for, was *continuing* a controversy which could be neither serviceable nor amusing to your readers; for this plain reason, *that they could not understand the merits of the case, as neither of the methods in dispute was described*. When Mr. Harrison quotes the meaning of a passage, he should, for his own credit's sake, quote it *fairly*; and not *give* the passage such a meaning as suits his own purpose, and which it cannot be tortured into expressing.

We will now pass to No. 345, in which Mr. Harrison gives us further proof of his mathematical attainments; he supposes the variation in length of a compensation pendulum to be $\frac{1}{10}$ of that of a wooden-rod pendulum; and says, "as the variation in time is as the square roots of the variation in length, it follows that the errors of the compensating pendulum will be 400 times less than those of the other," thereby making the square root of $\frac{1}{10}$ to be $\frac{1}{400}$ whereas the $\sqrt{\frac{1}{10}}$ is $\frac{\sqrt{1}}{\sqrt{20}}$ or $\frac{1}{4.47}$ &c. as almost any introduction to arithmetic will teach him. The steel-rod causes a variation in time of 8 seconds; the variation in length of a wooden-rod pendulum is said to be $\frac{1}{3}$ that of a steel rod; and, therefore, the variation in time will be $\frac{1}{7.1}\frac{1}{7}$ &c., or $\frac{1}{1}\frac{9}{7}\frac{9}{3}$ of that of the steel rod, or about $4\frac{1}{2}$ seconds per day, instead of "not quite one second." The variation in length is to be reduced by the compensating pendulum to $\frac{1}{10}$ of that of the wooden rod, and consequently to $\frac{1}{30}$ of that of the steel rod. The variation in time being as the square root of the variation in length in this instance will be as $\sqrt{\frac{1}{30}}$ or 1.03 seconds per day. Mr. Harrison, in consequence of setting the rules of common arithmetic at defiance, makes out that it would only vary $\frac{1}{1}\frac{1}{0}\frac{1}{0}$* of a second per day. A schoolboy would be whipt for such blunders. But this is not enough; he afterwards tells us that "*an error of one hundreth part in measure gives only an error of one thousandth part in time:*" now, according to his mode of calculation, which is to take the *square* of a fraction for its *square root*, it ought only to make the *one ten thousandth* part in time difference.

But the truth is, the variation in time is NOT as the square root of the variation in length; and I am sorry to be obliged to correct Mr. Harrison

* Mr. Harrison does not give this fraction; but by his own peculiar mode of reasoning, he makes it appear that a compensating pendulum will not "*vary in its rate a single second in several years.*" He, however, says a steel rod varies 8 seconds; a wooden rod 1-9th of the steel rod, or 8-9ths of a second; and the compensating pendulum 1-400th of the wooden rod, or 8-3600th of a second, which, being reduced, is 1-450th of a second in 24 hours.

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in a matter which he ought to understand much better than myself. It is well known that the numbers of vibrations which pendulums make in a given time, are in the inverse ratio of the square roots of their lengths; the *variation* in the number of vibrations, and therefore in time, must consequently be as the variation in the square roots of the *whole lengths*, and NOT as the square roots of the *variations* in their lengths, as may be thus demonstrated—

Suppose the number of vibrations which a pendulum makes in a given time, indicated by $x+v$, and its length by x^2. Conceive that by an alteration in temperature the length is increased to $x^2+2xv+v^2$; the number of vibrations (being inversely as the square roots of the lengths) will now be reduced to x. The variation in the length of the pendulum is $2xv+v^2$, and the variation in the number of vibrations, or in time, is v, which is obviously neither the square root, nor any other root of the variation in length.

But to give a more popular proof.—If a pendulum 36 long make five vibrations in a given time, one 25 long will make 6, and one $11\frac{1}{9}$ will make 9 vibrations in the same time. Here the lengths are as 100, 225, and 324; and the number of vibrations 9, 6, and 5. The difference of the lengths is 125 and 99, and of the number of vibrations 3 and 1. Now, by Mr. Harrison, the variation in time (or in the number of vibrations) is as the square root of the variation in length; therefore 1:3::$\sqrt{99}$:$\sqrt{125}$, or 1:3::9,949:11,18, but 1:3 as 9,949:29,847, and either this 29,847 is equal to 11,18, or Mr. Harrison's statement is *grossly erroneous*.

A steel rod pendulum will vary $\frac{1}{1061}$ of its length by an alteration of temperature of 30°, and taking the wooden rod at $\frac{1}{3}$, or, as Mr. Harrison awkwardly expresses it, at "three times less, it will be $\frac{1}{1591}$"; and calculating by the method I have mentioned, it will be found that the variation in the number of vibrations, or in time, caused by such a difference in length, will be something less than $2\frac{1}{10}$ seconds in 24 hours, instead of "not quite one second," as stated by Mr. Harrison; or of $4\frac{1}{2}$ seconds, as *his rule* gives when *properly worked*. It will also be found that when he has made his compensating pendulum to vary only $\frac{1}{10604}$ of its length by an alteration in temperature of 30 degrees, that such variation in length will cause a variation in time of $\frac{1}{20}$ of a second in 24 hours; or *sixty-seven and a half times the variation stated by Mr. Harrison.*

I will not make a single comment upon the conduct of a man who erects himself into a "refuter of false principles;" and gives such decided evidence as I have been *obliged*, in my *own defence*, to point out, of having no settled, well considered notions of his own, and of not understanding the fundamental principles of the art of which he writes. I will take an opportunity of examining the whole of the church-clock correspondence, and see what is the "head and front" of Mr. Wynn's offending, and send you the result; for if I have power to prevent it, no man shall be treated in the illiberal and *unjust* manner in which Mr. Wynn has been treated, for no other reason, as far as I can perceive, but *because the Society of Arts has rewarded his ingenuity.*

What Mr. Harrison says of "mere anonymous correspondents" is of no consequence; however, if he will point out that your readers will gain any thing by knowing my real name, &c. &c., I shall be tempted to give it; but, I apprehend, it does not matter to them *whence* the truth comes—all they are concerned to know is, whether that which is put forth for truth *really is so*; and influenced by this opinion, I subscribe myself the sincere well-wisher of every well-meaning mechanic.

S. Y. (an engineer.)

April 14, 1830.

P.S.—Since writing the paper alluded to above, I find Mr. Wynn's improved hammer was described in No. 45. My saying it was not, was an error of memory, which, I trust, most of your readers will deem excusable.

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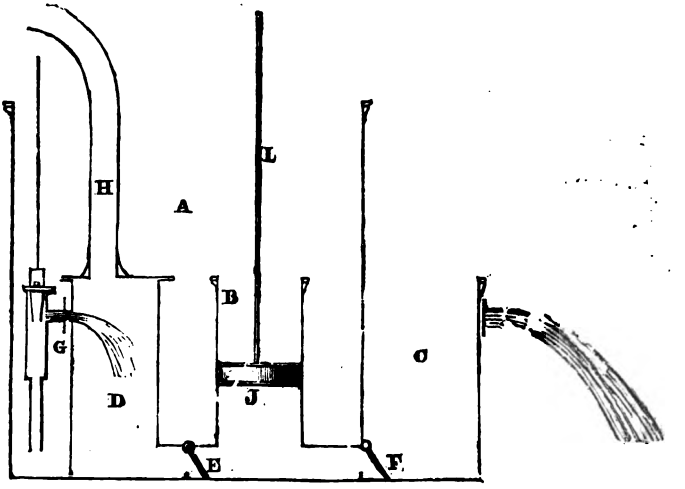
AIR-PUMP ON THE PLAN OF THE FORCE-PUMP.



Sir,—The prefixed figure represents an air-pump wrought upon the principle of the force-pump, with solid piston. It may possibly be inferior to one constructed in the ordinary manner, but I should like to see this demonstrated.

A is the cold-water cistern; B, the air-pump; C, the hot-well; D, the condenser; E, the foot-valve; F, the delivering-valve; G, the injection-pipe; H, the condensation-pipe; I, the rod of the air-pump; J, the piston of the air-pump, &c.

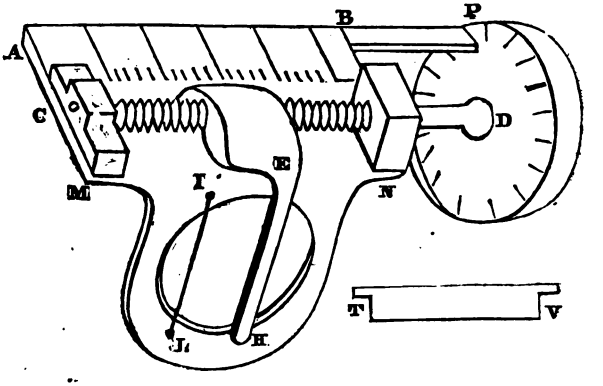
By inserting this in your valuable publication, you will greatly oblige,

Yours respectfully,

GEORGE DAY,
(A Practical Mechanic.)

Cleckheaton, Nov. 17, 1829.

ADVICE TO YOUNG ASTRONOMERS, AND DESCRIPTION OF A CHEAP MICROMETER. BY MR. W. SHIRES, MATHEMATICAL TUTOR.



Sir,—As it frequently happens that young people throw away their money in buying a cheap astronomical telescope, it is well to make them sensible of their chances of disappointment, and of the necessity of getting one capable of being perfectly distinct with a power of 300 or of 400, without

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which it will not give satisfaction. To observe the angle in which a planet or fixed star will appear, his first experiment should be to have cross wires for his micrometer, and by the beats of a half-second watch held at his ear, he should count the beats while the planet passes the wire, which multiplied into 15 times the cosine of the planet's declination, and divided by radius, will give the angle in which the planet appeared. After this he will be able to use other micrometers and instruments tending to his designs. The following is a description of a cheap micrometer which I some time ago invented, and have put into practice.

Let BIH be a plate of brass bent at right angles in the line MN, and cut as per figure, to which an endless screw DC is fixed, and also a wire LI. Now, by turning the screw, EH will always move parallel to the wire IL, so that the apparent diameters, &c. will be measured betwixt the two edges of LI and EH, which quantity may be read off on the plate AB, and subdividedly on the head of the screw to which P is a pointer. To apply the instrument to a telescope, a cross opening must be cut in the tube of the eye-piece, like that represented by TV, and exactly at the focal length of the eye-lens from that lens; into which opening the part IHN of the micrometer being pushed, the telescope will then be prepared for the observation designed.

I am, Sir,
Yours, &c.
WM. SHIRES.

AEROSTATION.

Sir,—In numbers 298 and 299 of the "Mechanics' Magazine," your readers were amused with a plan for flying in the air, which, though ingenious, would, I fear, be found impracticable. A modification, however, of a part of your correspondent's contrivance, might, I think, be found useful in the construction of balloons. The method I propose is as follows:—

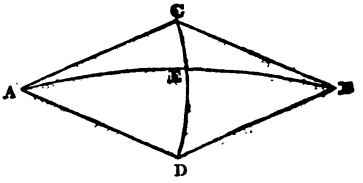
Let four bags be made, of sufficient dimensions, similar in form to the quarters of an orange. They should be covered with a suitable varnish for the retention of the gas, and enclosed in net-work, so as to form a spherical balloon. The objection to this arrangement which might be made on account of the increased weight of the balloon, will be counterbalanced by the additional safety, as a fourth part only of the gas could escape, should one of the quarters sustain accidental injury.

In the centre of the car let a light *mast* be fixed; the most suitable material for which would probably be found to be five or six canes bound together.

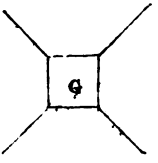
The peculiar construction of the balloon will allow this mast to pass up through the middle, and it should be of sufficient length to extend five or six feet above the top.

At the extremity of the mast a sail of the following description should be fixed:—

Fig. 1.



AB and CD are strong pieces of cane, or slender cane bound together; on these a cloth ACBD, is to be stretched. The canes are to be arched, and kept so by cords arranged, as seen in fig. 2.



Through the opening G the mast is to pass, and it is to be fixed to the sail at E (fig. 1.) by a universal joint.

The sail is to be managed by cords attached to the corners, which, passing between the separated quarters of the balloon, are to be fixed to two small windlasses in the car, by means of which the sail will be completely manageable by the aeronaut. If the friction of the cords against the balloon should be thought likely to injure it, fixed tubes of trifling weight might be provided for them to work in.

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By the adoption of this plan, the rotary motion of the balloon will be prevented, and considerable buoyancy obtained, as much it is presumed as will compensate for the weight of the machinery; when the gale becomes violent, or the aeronaut wishes to descend, the edge of the sail must be presented to the wind. By judicious management of the sail the descent will be rendered much more gentle than is usual. Presenting the upper side of the sail to the wind will cause the balloon to descend (if the wind be strong enough), and this will be found a more eligible way of effecting a descent than suffering the gas to escape, which, of course, occasions a *permanent* diminution of buoyancy.

I venture to send you the above, thinking that a crude plan, even if it be found impracticable, may be the means (if publicity be given to it) of eliciting something much more worthy of attention.

I am, Sir,
Your obedient servant,
DAVID JOHNSON.

THE LONDON UNIVERSITY.

[The Letter "to the Shareholders and Council of the University of London," alluded to in the following communication, is subscribed by Dr. Conolly, Professor of the Practice of Physic; Mr. A. de Morgan, Professor of Mathematics; Dr. Lardner, Professor of Natural Philosophy and Astronomy; Mr. Long, Professor of Greek; and Mr. M'Culloch, Professor of Political Economy. The object which it has in view is to obtain a rectification of certain orders of the Council, which the learned Professors consider to be among the chief causes that the halls of this University are not yet so "crowded" as could be wished. The *first* topic discussed is the amount of the fees charged for the lectures. At present the average cost of a course of lectures, commencing in November, and continuing till the middle of July, is about 7*l.* 10*s.* The Professors say that "if the amount of the instruction be considered, this cannot be justly accounted dear;" but they admit that the public have taken up a different opinion, and they therefore recommend "a reduction of fees" as likely to be of "great advantage." For our own parts, we think the public are quite right in their opinion. A fee of 7*l.* 10*s.* for any course of lectures that can be delivered by any body from November to July is enormous; it would buy all the books that are worth buying, or many of the subjects lectured upon. According to the Professors, the people of London have caught up their cheap notions on this head, from the prices charged at the Royal and London Institutions, where the courses of lectures are not only much shorter than those delivered at the University, but, on account of their restricted limits, necessarily very defective. But have the Professors never heard any thing of the prices charged at the Scottish colleges, where the courses are as long as need be, and the Professors not without some renown for producing good scholars? At Edinburgh "the average cost of a course of lectures" is little more than half what is charged at the London University. The *second* grievance complained of by the authors of this "Letter," is the great length of some of their courses, which they consider "an obstacle quite as formidable as their cost."—"We cannot expect," they say, "at least for many years to come, to draw any considerable number of students from the upper ranks: it is principally on the youth of the middle ranks that we must depend; and if we wish to succeed, we ought to accommodate our lectures to their convenience. It seems to us, that in certain parts of science and literature, *an eight months'* course of lectures is under any circumstances far too long, and it is especially so in the situation in which we are placed. Young men of the middle ranks, from sixteen to eighteen years of age, in this busy metropolis, cannot afford to attend prelections to such an extent. Besides, we are disposed to think that such a sacrifice on their part is altogether unnecessary. The information most desirable for them may be communicated in a much shorter time. The object of lectures is not to convey to the student all the attainable information on the subject treated of, but rather to give him general views, to indicate the sources whence more minute knowledge may be derived, to specify the points that involve any real difficulty, or with respect to which different opinions are entertained, and the mode in which he ought to pursue his own investigations with respect to them. The process of *cramming*, as it has been expressively termed, is not one which we feel inclined to recommend. The object should be not so much to reason for the student, as to

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teach him to reason for himself." We could not wish for a more sensible exposition of the ends to be aimed at in public lecturing than is here given; and think the "Council and Proprietors" will do wisely to leave it to men who know their duties so well, to determine the length of time which is requisite to perform them. We can state of our own knowledge, that the great length to which the courses of lectures at the London University at present extend, has deterred several young persons from joining it; and have heard that other individuals, as well as the Professors, have felt what it is to be tired of cramming. The Professors seem disposed to except the Greek, Latin, and Mathematical classes, which do not, they say, "consist of courses of lectures, and are (therefore) not too long." But this, which is the only reason given for excepting them, we conceive to be just no reason at all. It is not by *courses* alone that people are crammed. Nor is cramming with Greek and Latin and Mathematics a whit more uncommon, than cramming with Philosophy or Physic, or even Political Economy. Besides, "young men of the middle ranks, from sixteen to eighteen years of age, in this busy metropolis," can no more "afford" to attend eight months' courses of instruction in Greek, Latin, and the Mathematics, than they can "afford" to devote that time (at once) to any other branch of knowledge. The *third* topic treated of in this "Letter," is the amount of the emoluments secured to the Professors. Since the opening of the University they have had guarantees of certain sums from the Council; that is to say, the Council engaged, that if the fees arising from the classes should not attain a specified amount, the deficiency should be supplied from the University funds. It has been recently intimated, however, that these guarantees are henceforth to be discontinued, and that each Professor's entire renumeration is to consist of two-thirds of the fees paid by the pupils attending his class. We agree with the authors of the "Letter," that a resolution more fatal to the prosperity of the University could not have been taken. "No one," as they truly observe, "can properly discharge his duties as a Professor, or expect to recommend himself to public attention, if he does not specially devote himself to the study of the subject he is appointed to teach. This he cannot do, unless he derive from his situation as Professor, an income at least sufficient to secure him *against want*. Can it be imagined, that a man having perhaps a family to support and establish, will devote himself to a pursuit unproductive of immediate pecuniary advantage? Yet to discharge efficiently the duties of any Professorship in the University, this must be the case. The Professors must therefore either derive incomes of a moderate amount from the University, or they must seek elsewhere their principal means of support. If they be forced to take the latter alternative, it is not difficult to predict the catastrophe of the London University." Again: "It would be easy to show that there is not a branch of science or literature that is not sufficient to engross the principal part of the time and attention of the most able Professor. It is indispensable to the welfare, or rather to the continued existence of the Institution, that no Professor should be left to rely wholly, or principally, on other sources of income, for the means of acquiring a decent subsistence. A Professor, who derives the principal part of his income from avocations not closely related to his academical studies, may go formally through the routine of his class, but it would be visionary to imagine that he would do more. Where a man's riches are, there will his attention and best energies be directed. If the Professors be thrown entirely on external resources, and compelled, as many would be, to trust principally to other means of support, the success of the University cannot be secured: they will embrace the first opportunity of withdrawing from an Institution where their situation is so precarious. If these places be supplied by persons of inferior qualifications, the classes at present most numerous will fall off. The credit or discredit of one chair redounds to the honour or disgrace of the rest; the department of the general school cannot be expected to flourish while the others languish. If all be not placed upon a most solid foundation they will sink, perhaps not together, but the delay of one will not long precede that of the others." All most cogent reasons, in our humble opinion, for revising and rescinding the niggardly resolution complained of, and the more deserving of favourable consideration, that the Professors who urge them are precisely those who, from the present magnitude of their classes and the popularity of the departments intrusted to them, have the least reason to care for the effect which the new rule may have on their individual incomes. It is not the case of one or two Professors which is here

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pleaded, but the case of the whole collegiate body. "All cordially agree, that their real interests, which are also the interests of the University, are identified with these of their colleagues. None can feel at ease while any sustain the pressure of even temporary difficulty. None can feel their united exertions rewarded, while any labour with disproportionate remunerations." Large salaries, be it observed, are not sought; all that is contended for is, that every Professor should be ensured such a "moderate remuneration," as may remove "every solicitude for providing the means of immediate subsistence." Should it be imagined that the Professors might in that case be tempted to relax in their exertions, an excellent method is pointed out by which this suspicion may be effectually removed. "Let the salary granted be gradually withdrawn at a certain rate in proportion to the increase of fees. For every two pounds of fees, let one pound of salary be deducted, and the Professor's income will receive an increase at the rate of one pound for each student who may attend, yet at a certain point he will altogether lose his salary. Thus while the Professor will be secured, even the most suspicious must admit that it will be the interest to improve his class." All, in fine, that wants to be done in the opinion of the writers of this "Letter," in order to render the London University as prosperous as its warmest friends can desire, is to do these three things—to make the Professors sure of earning a respectable subsistance by their academical labours—to make the courses of lectures much shorter—and to reduce the fees considerably. We are not prepared to say that these are all the reforms desirable in the organization of this establishment; but sure we are, that there are none more imperiously demanded, or which would, in all probability, be attended with more saving consequences. The communication from a correspondent, which has called forth this introductory notice, points out a defect in regard to the discipline of the University, which is also well deserving of attention.—ED. M. M.]

Sir,—I have the honour, or the misfortune (as the case may be), to be a shareholder in the property of this important institution. No person can more sincerely wish it success than I do, nor any one regret more when circumstances occur which seem to put its existence in jeopardy. I have lately received a printed letter, signed by *five* of the professors, which, though it is not, strictly speaking, *published*, has been circulated amongst all the proprietors, amounting to between 12 and 1500, is fully and freely canvassed, as they meet in groups at the Royal Exchange, and elsewhere, and may therefore be *publicly* adverted to without any breach of faith. A secret in the possession of several hundred persons is no longer *a* SECRET.

I enter not into the question of the prudence of these professors in circulating this letter. I think they are quite defensible as to the measure; though some of the opinions which they advance are doubtful. I will not, however, expatiate upon these: you, I dare say, have seen this printed document; and as it relates to a concern of great moment, I trust that you will animadvert upon it with your accustomed acumen, frankness, and fairness.

I shall, therefore, here advert simply to one topic, namely, the adjustment of "the balance of power" in this new university. Nearly every thing, as to permanent success, will depend upon this adjustment. With all the defects of our older institutions, our colleges, and public schools, they stand upon high ground here. A college tutor, nay, every college functionary, from "the head of the house" to the chapel clerk, has the extent and measure of his duty and authority so clearly prescribed, that no one infringes upon the authority of another, and every one receives his due share of respect. One remarkable, but unquestionable, consequence is, that *generally* the deans, tutors, sub-tutors, &c., are the most fit men for their respective functions which the college supplies; and the universal feeling that this is the case, causes all the operations of the college to go on smoothly, and without fear of any disgraceful failure; at least, in a college of the least respectability.

But have we any thing analogous to this in our London University? There are the council, the warden, the professors, ALL, I verily believe, discharging the duties they have seve-

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rally undertaken with the utmost activity, vigilance, and uprightness. But where is the fountain of authority? Who holds the rod? Who can punish? Who can expel? If a youth, or a dozen, behave indecorously or impertinently at a lecture, or during a lesson, what is to be done? At Oxford or Cambridge every one would know what must be done. But in Gower-street, in such cases, all, if I mistake not, would be perplexity. The professors would not refer to the warden, because they regard him as the mere secretary or agent of the council. The warden expects the reference to be made to him, as the permanent representative of the council. And the council expect the reference to be at once made to them, as the only legitimate source of authority. All this, and more than this, the shrewd, observant youths who study at the institution know better than I do, and as well as either the council, the warden, or the professors; and this knowledge tempts them to plot and contrive new aggressions. Thus the evil augments, and will augment, unless the council, instead of attempting to smooth matters down and stave off the discussion, meet it manfully *at once*, and determine upon what principles and on what occasions the professors shall exert, and be supported in the exercise of that authority which is manifested in punishing, without delay, an obvious offender. Had I the honour of being a member of council, I would bring forward this topic of discussion at every meeting until it was wisely and finally arranged. It is in the humble hope that the present communication may serve to convince the council of the immediate necessity of looking this evil fully in the face that I have addressed it to you; and hoping you will lend your powerful aid to the arrangement of this and other points of moment, by occasional suggestions for the consideration of the council, who, as liberal, thoughtful, men will doubtless listen to advice.

I am, Sir,

Yours, &c.

A SHAREHOLDER, L. U.

THE LONDON MECHANICS' INSTITUTION.

Sir,—You say I owe "an apology" to the managers of the London Mechanics' Institution, for the terms in which I have spoken of them; but the worst you have charged me with is not speaking to evidence, and before a man can apologize with sincerity to persons he has offended, he must be convinced that they are morally, as well as legally, innocent of the things imputed to them. Now, though there may be no legal proof that the managers are actual abettors of infidelity and anarchy, there is at least abundant cause for suspecting that they hold them in no particular dislike. My own firm belief is, that there is not half a dozen of them who could lay their hands on their hearts, and plead "not guilty;" and till I can be persuaded to the contrary, I must, with all due respect for your admonition, abide by what I have written. There is one fact which, according to the very proper rule of construction you have laid down, should at once put to shame all their pretensions to neutrality. They *refused* the use of the Theatre, on the Sabbaths, to the body known by the name of Free-Thinking Christians, though they offered to pay 60*l.* a year for it, while they have let it to the all-religion-denying Mr. Owen for the little more than nominal rent of 10*l.* The distinction is small, perhaps, but it is still a distinction. The Theatre is closed against a class of persons who do acknowledge the Christian religion, though in a way of their own, while it is thrown wide open to a gentleman who laughs not only at the Christian, but at every other religion! He must have large ears who can listen after this to any protestations of neutrality from such a quarter.

I remain, Sir,

With much respect,

HENRY SIMPSON.

Sunday, 23rd *April*, 1830.

Sir,—I have read with great satisfaction what is contained in your Magazine of yesterday, in condemnation of the base uses to which the Mechanics' Institution has been turned. But how is it you have overlooked the flagrant violation of the Sabbath, and of the laws of this Christian land, which is involved in the letting of the

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Theatre on the Sabbaths, to Mr. Owen ?* I see, by the newspapers, that Mr. Owen exacts a shilling from every person who goes to hear him ; so that besides breaking the Sabbath in a religious sense, he, and all concerned with him, are guilty of a breach of the Toleration Act, which forbids, under severe penalties, money being taken for admission to any place of public meeting on the Lord's-day.

I am, Sir,

Yours, &c.

A CLERGYMAN.

Gower-street, April 24, 1830.

P.S.—How is it that such things are *permitted?* There was a time when the public authorities would have thought it, in such a case, their duty to interfere. A facetious friend near me will have it, that it is all owing to the mother of abominations wearing a *Scarlet* cloak.

Sir,—Will you give me leave to put two questions, through the medium of the "Mechanics' Magazine," to Dr. Birkbeck.

Is not Dr. Birkbeck a personal friend of Mr. Owen, and a convert to his principles? And did not Dr. Birkbeck, in one of the committee discussions on the subject of letting the Theatre to Mr. Owen on the Sabbaths, use this memorable expression, that "breaking the Sabbath was but a phrase of the priestcraft for breaking through the trammels of prejudice and superstition."

I am, Sir,

Q. in the Corner.

London, April 28, 1830.

* It *was* an oversight, arising doubtless, from the circumstance of our writing with a (printer's) devil at our elbow, and from no disregard to the importance of this peculiar consideration.—ED. M. M.

GENERAL MEETING OF THE MEMBERS.

(From a Correspondent.)

The committee of the London Mechanics' Institution having refused to call a general meeting of the members, to consider of the means of averting the disgrace likely to be brought upon it by its reputed connexion with radicals and infidels, the requisitionists called a general meeting on Tuesday last, on their own authority. The attendance of members was unusually numerous, and the discussion which ensued long and stormy. Mr. Reynolds, who took the lead in the requisition, moved a resolution to the effect, that the theatre should not be any more devoted to such evil uses as it had heretofore been. The vagueness of this resolution was much complained of, even by those most friendly to it; but no better was offered as a substitute. Mr. Alderman Key, the treasurer, and Mr. William Tooke, the respectable solicitor to the Institution, both expressed themselves in decided terms of disapprobation of the letting of the theatre for political and irreligious meetings, and more especially of the permission given to Mr. Owen to lecture in it on the Sundays. It was also mentioned in the course of the evening, that Mr. Brougham had given a strong opinion to the same effect. Mr. Owen (though we believe no member) tried to be heard in vindication of himself and the committee; but the uproar occasioned by his appearance was so great, that it was found necessary to bring the meeting to a close by a resolution of adjournment till the following Thursday.

A SONNET.—NO. II.

When in the heavens, mysterious comets blaze,
A wondering world astonish'd, silent gaze ;
Presaging horrors from its sudden light,
They shake, while they admire the flaming sight:
So the fierce warrior seeks ambitious fame,
Through a red track of ruin, blood, and flame,
His dazzling splendour draws a sad surprise,
From thousand hearts bereav'd, and weeping eyes.

But in the sky there rules a gentle star,
For ever bright, it shines with silver ray ;
The way-lost traveller sees it beam afar,
Hails its fair light, and joyful wends his way !
So to the men of science, nations raise
Their noblest monuments, their gladdest praise!

T. M. B.

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HISTORICAL NOTICES OF INVENTIONS AND DISCOVERIES.

Mr. Wedgewood.—The greatest part of the earthenware now made in England is manufactured in a particular district of about ten miles in extent well known by the name of the Staffordshire Potteries. Here earthenware has probably been made ever since the time of the Romans (very evident remains of Roman potteries having been repeatedly discovered at a considerable depth below the present surface of the land); but there does not appear to have been any ambition among the manufacturers to improve the art, or to produce any works of taste till the late Mr. Wedgewood engaged in the business. This most excellent man brought modellers from Italy, and from other parts of the Continent, whom he engaged at high wages; and he also constantly employed a competent chemist in experiments, that nothing might be wanting which could conduce to extend the employment of earthenware throughout Europe, or that could in any way tend to give permanency to the staple manufacture of the country which had given him birth.—*Perkes.* Wedgewood was the son of a potter in Staffordshire, and from early youth was employed in his father's business. His education was very limited, and his patrimony small; but his mind was vigorous, and he soon manifested its superiority by the improvements which he introduced. By him was invented the Wedgewood or Queen's ware, which soon not only excluded the foreign manufacture from the market, but also supplied a large quantity for exportation, and gave a new spur to trade, extending the business far beyond all former example. As he acquired wealth he liberally expended it for the promotion of the arts, particularly in their application to his own business. The figures on his cameos and intaglios rivalled the productions of ancient Greece. By his means the district which he inhabited became the centre of a vast population, and a place of great wealth. He lived highly esteemed for his moral and intellectual qualities, the associate of men distinguished for genius and science, and died universally regretted.—*Jones's Address to the Franklin Institute.*

Carding-Machinery.—"A self-acting machine was invented here thirty years ago for making wire cards for preparing wool and cotton; it bended and cut the wires, pricked holes in the leather, and inserted the bended teeth into these holes by one operation, without manual labour; a patent was taken for the invention here by Messrs. Sharp and Whittemore in 1799. The machine was very ingenious, and was made to operate with rapidity; but the cards produced by it were too coarse and imperfect to be used with advantage in this country, where the art of card-making by hand had previously been brought to great perfection; the inventor, therefore, carried his machine to America, where coarse cards were more in requisition; and as our laws prohibited the exportation of any of our cards, the want of efficient card-makers in America rendered a self-acting machine of value there, although not very perfect in its operation: he succeeded in America so far as to carry on a trade, and by practice improved his machinery till it supplied the American demand very well. A Mr. Dyer, who was at that time a merchant, became acquainted with the invention, and thinking it had attained a state of perfection sufficient to be re-exported with advantage to England, he purchased the invention, and came over here to take out a patent when the original patent was nearly expired. Mr. Dyer ultimately began a manufactory at Manchester. When the cards manufactured by this machinery began to be sent out to the cotton and woollen mills, they were found still too coarse and imperfect for efficient use in England; and Mr. Dyer though not originally a mechanician, set himself to study the subject until he was able to improve the machinery, and make saleable cards by it. His first set of machines were all destroyed by fire at an early period of his settling in Manchester, and he lost much property; but in the end, that circumstance ensured his success, because he made entire new machines with many improvements that he had found out before the fire, but which could not have been applied with so much perfection by altering the original machines as in making new ones. He was obliged to take another patent for these improvements, and has had other patents since; and has established a considerable trade with great advantage."—*Mr. Farey's Evidence on the Patent Laws.*

Machine for Cutting the Teeth of Cog-Wheels.—"I did business formerly for a very ingenious mechanic at Sheffield, named Gilpin, who destroyed himself some years ago. He had a machine for cutting the teeth of cog-wheels, and another for making hard steel spindles for cotton-spinning. The works he produced by them were most excellent; but he kept the means secret, and I do not think they have been practised with any effect since his death."—*Ibid.*

Bleaching by Means of the Fumes of Sulphur is said by Pliny to have been employed as early as the first century. It is also mentioned by Apuleius, who tells a story of a gallant who was nearly suffocated by taking refuge under a wicker-coop where cloth was hung to be whitened by this process.

INTERIM NOTICES.

On the first Saturday in June next, the Editor of the "Mechanics' Magazine" will commence a new weekly Journal, to be called the "SPIRIT OF LITERATURE." It will be conducted on a plan, in many respects, entirely new; and be distinguished more especially for its cheapness and comprehensiveness. A gratis copy of No. I. will be sent to each of the Subscribers to the "Mechanics' Magazine," and to that specimen the Editor begs to refer for a developement of the grounds on which he confidently hopes for their unanimous support to this new undertaking.

"A Practical Engineer, but not a Practical Calumniator" brings only "flowers from Billingsgate" to the aid of the party whose side he espouses. We have had enough of this sort of reasoning already.

S. Y. is requested to send to our office for a packet addressed to him.

We have perused with attention the paper of "J. P. of Clerkenwell," and our first impression is one of great doubt as to the truth of the discovery which he supposes he has made. We shall, however, examine it again at our leisure, and if we think better of it, give it a place.

Communications received from Mr. Oliff, (for whom we shall endeavour to procure the information he wants)—M. W.—O N. O.—Mr. Dennet—A Bee-Fancier—Elias—Juvenis—A Father and Master—Mr. Harrison.

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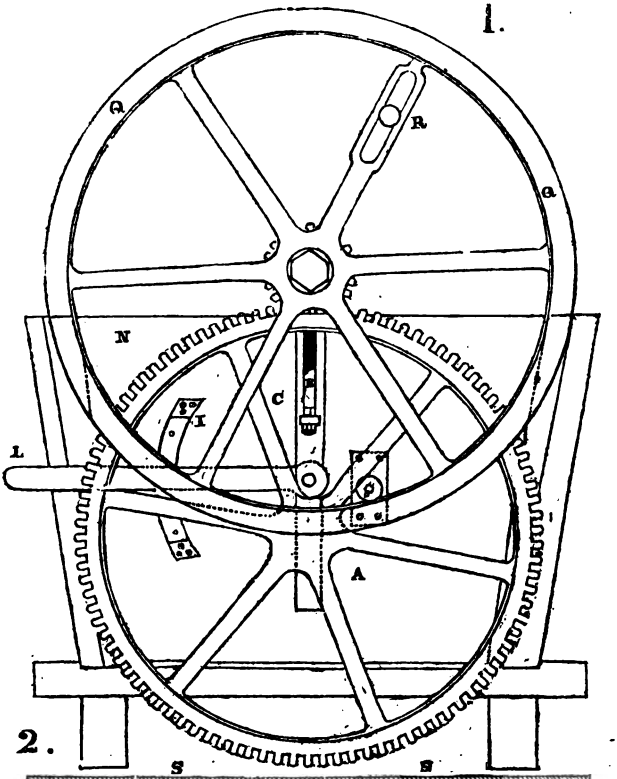
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 352.] SATURDAY, MAY 8, 1830. [Price 3d.

MECHANICAL BREAD-MAKER.

1.



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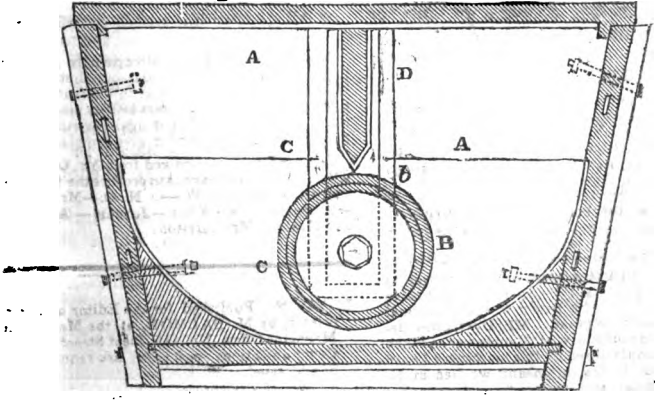

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MECHANICAL BREAD-MAKER.

Among the novelties now exhibiting at the National Repository, there is one which though it has, strictly, no business there—being a foreign and not a native production—is yet extremely well deserving of attention from the British public. It is a model of a Petrisseur, or Mechanical Bread-maker, lately invented by Messrs. Cavalier, Brother, and Co., of Paris, as a substitute for the uncleanly and disgusting practice of bread-making by the naked hands and feet of men. We understand that it is coming rapidly into general use among our French neighbours, and trust that we shall not be slow in following their example. The continuance of the present practice is a real disgrace to civilization.

Fig. 1, of the accompanying engravings, exhibits a principal end-view of the machine; fig. 2, an interior section; and fig. 3, a lower end-view.

The following descriptive particulars we extract, in a condensed form, from a small pamphlet which Messrs. Cavalier and Co. have written with the benevolent view of introducing the machine to the notice of the British public, and enabling all who may be desirous of "*pain a la mechanique*" to have mechanical bread-makers manufactured "under their own direction," and at the least possible expense.

The machine consists of five principal parts:—1. AA, a trough or box for holding the dough, made of oak, lined with sheet-iron, with a close cover SS, and a round bottom. 2. B, a hollow cylinder or roller made of cast-iron, with an axis of wrought-iron, which is lodged in the seats CC. 3. D, a scraper or dough-cutter, which divides the trough lengthways into two equal parts, and is composed of a thick oaken board, the under part of which becomes gradually thinner till it terminates in a sharp angular point covered with iron. 4. LL, a lever for regulating the distance between the under part of the roller and the bottom of the trough, according to the required thickness of the dough. And, 5. wheel-work by which the roller is turned, consisting of a cog-wheel and pinion N, and fly-wheel Q, with its handle R.*

The *scraper* is one of the most delicate parts of the machine, and demands in its adjustment the utmost care and precision. It ought to be exactly at right angles with the roller. When it is otherwise, the defect will be at once perceptible from the circumstance of the scraper pressing too hard upon the roller in some places, while it is too distant from it in others for the due performance of its particular function; namely, that of clearing or cutting off all adhesions from the roller at each revolution. Sometimes the scraper will be thus defective owing to carelessness in the construction of the machine; at others, owing to its expansion or contraction through the dampness or dryness of the place in which the machine is placed. In all such cases it must be regulated anew in the following manner:—Begin by taking off the bored balls or counter-box G from the top of each of the two screws EE placed vertically at the extremities of the trough; then turn aside the nut or box of the screw gently; and, next, turn the same screw, by means of the square head, to the right or to the left until a very thin card, placed between the scraper and the roller, can be moved the whole length of the trough—meeting, however, with a slight resistance. That done, press the nut against the cast-iron pieces near which it is, and replace the balls. Should the exact parallelism required between the scraper or roller not be thus obtained, the iron edge of the former must then be rendered straight and smooth by filing.

The distance between the roller and the under part of the trough must be uniform throughout its entire length; and care must, therefore, be taken that the levers which regulate this length are always placed in the corresponding holes (M) at each end of the roller.

The seats CC have a shaft K projecting from them which enters an

* Machines which are constructed for manufacturing a lesser quantity of dough than 300lbs. at a time have no fly-wheel, and the handle or winch is fixed on the axis of the pinion.

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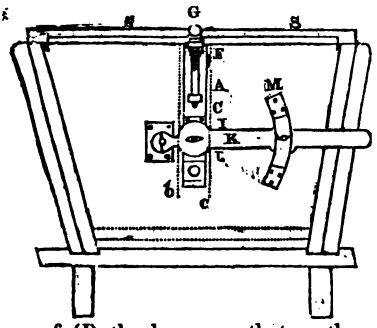
Fig. 3.



eye of (J) the lever; so that as the roller is raised or lowered, they are raised or lowered in like manner.

Accompanying the machine there are the following detached appendages:—1. Two fountains, which have a threefold object: in the first place, to diminish the capacity of the machine at will, so as to operate upon a smaller quantity of dough than that for which it was originally intended; secondly, to enable the operator to form several sorts of dough at one and the same time; and, thirdly, for the purpose of manufacturing leaven only. When the operation is to be performed on a small quantity of flour, it is always advantageous to diminish, by means of the fountains, the length of the space occupied by the dough, and thus force the flour to rise higher on each side of the roller. There are three iron pins which fix the fountains upon the border of the machine, and upon the scraper, besides which there is a fourth, which must also be placed across the same scraper, towards the bottom, and in a hole formed for that purpose: without this precaution, the fountains could not remain in the vertical position which is indispensable for the fulfilment of their object. 2. A rake, which serves to break and spread the leaven; or, if desired, to form a light mixture, previous to the turning or working of the roller. 3. A tin grapple, which is intended to convey the flour to the trough. 4. Two small boards, by means of which the flour is made even, after it has been put into the trough and diluted. 5. A hand-knife, which may also be called a dough-cutter, which is used to cause the dough that may have adhered to the partition of the trough, to fall at every turn, and to cast the last particles under the roller. 6. A spatula or flexible knife, which serves to complete the cleansing of the trough, at the end of every operation, by taking away the least remains from under the roller; it likewise serves to withdraw any dough that may stick to the rake, after the process of diluting is finished. It is also employed, instead of the hand-knife, to detach the dough usually found adhering to the partitions of the trough. And, 7. A key, or turn-screw, for fastening and loosening the screws, and especially for the working of those destined to regulate the exact distance from the scraper to the roller.

The following are the instructions given for

"*Preparing the Leaven and the Dough.*

"The dough reserved from a preceding baking, and which is allowed to *ferment*, or become sour, is what is commonly called chief, or first leaven. To make this leaven, that is to say, of the first degree, the length of the trough must be reduced, by means of the fountains, in such a manner as to form two squares or divisions, adapted to the quantity of leaven intended for use. The roller ought then to be placed, and kept at its lowest point. A small quantity of flour is to be put behind the fountains, to prevent the running of the water; then the *chief* leaven is made to fall into one only of the squares which have been formed, and the water destined to dilute it is poured in: this act of diluting is performed with the assistance of the rake. When the leaven is dissolved, or nearly so, the flour which is to augment it is thrown over it; the roller is raised to its highest pitch, and the handle is turned, that the mass may accumulate under the roller. The operation of *turning* must be continued, on the *same side*, as long as any portion of it is seen to pass from one compartment of the trough to the other. As the motion gradually ceases, turn the handle in the opposite direction, and so on till the *alloy* be collected into one side or compartment only.

"This operation would be abridged if, after having thrown the flour into the trough, the whole were to be mixed with the rake; because the mass or

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matter having then some solidity, would accumulate the more easily and readily under the roller; and one of the compartments of the trough would be emptied without the necessity of turning the handle so long, or in an opposite direction.

"Allusion is made to the first mode of operation, merely to show that the use of the rake is only of absolute necessity while diluting.

"When one side of the trough is emptied, the leaven or alloy is made to pass from the other, by turning the handle in an inverse direction; and the same act must be continued till there is a sufficient quantity of dough, and till it attains the desired state.

"It will be therefore necessary, for this purpose, to lower the roller one degree every other turn.

"In order to render this leaven what is called the *second degree*, it is only necessary to enlarge the square: the same thing is done for the leaven denominated complete. Generally, the leaven is augmented or refreshed three times, and the weight is then about 200lbs., in the bake-houses at Paris; but if it be the custom, at any particular bake-house, to make more or less than three leavens, there is no inconvenience or objection. The last, or perfect leaven, is to be kept, by means of the fountains, on both sides of the trough, in a square so compressed, that when it reaches its highest point of fermentation, it may fill, and even overflow the said square.

"The roller then being lowered to its last degree, the fountains are withdrawn; the leaven is spread all the length of the trough; all the water considered necessary for the oven-full is poured in at once, and then diluted with the rake, in the manner already stated. This operation, executed *by one man*, requires only three minutes' labour for 200lbs. of leaven.

"The business of diluting concluded, all the flour is put in at once; its quantity is to be calculated with all possible correctness; but care should be taken that there should be a deficiency rather than an excess, for it would be preferable to have to add flour, than water.

"The flour ought to be spread with the small boards, so as to form an even surface on both sides of the machine. It will then be necessary to raise the roller to its highest degree, and to act as before stated, when treating of the leavens; using the rake or not, at pleasure.

"If, in the course of the first turns of the roller, the dough appear too soft, add as much flour as will prevent the necessity of using more afterwards. Too much confidence must not, however, be placed in first appearances; because later, and especially when the dough is on the board, or in the fountain, it acquires more solidity than might at first be expected.

"This part of the process concluded, the roller is lowered one degree, at which point the dough is made to take two turns, that is, to go and come, or pass and return; after which the roller is made to descend to the last point or degree, when the dough should pass successively from one department of the trough to the other, till it be sufficiently kneaded. At Paris the dough is generally made in five or six turns. Before the last turning, and when the dough occupies only one side of the machine, a fountain is adjusted on the empty side, so as to form a square, or space in which the *leaven* for the following oven-full is deposited.

"As this square is generally found too small, in Paris, to contain all the leaven, in its state of *fermentation*, therefore, when the opposite one is empty, the other fountain is fixed, facing the first, and the leaven distributed in both, so that when the fermentation increases, none of the matter may run over the sides. To encourage fermentation, the dough is usually covered. The firm and the wet dough are kneaded in the same manner; except that for the former the number of turns is to be reduced, unless particular precautions become necessary, from the degree of fermentation of the leaven, or other motives.

"In every such case, the baker or operator, can easily determine with propriety and sound discretion. The operation of wetting, is made by sprinkling the dough over with water, by means of a brush, taking care to turn the roller at the same time; because, by thus constantly presenting a new surface, every part of the dough becomes equally damp. For the purpose of withdrawing the dough from the trough, it may be taken upon the roller as it comes in large pieces against the scraper. Each piece is put into a common basket, whence it is taken to be formed into loaves, &c.; but this mode is only adopted where the machine is in a different situation from the bake-house, and where the weighing cannot take place. In the contrary case, the dough is left for preparation in the compartment in which the last turn of the roller has lodged it, and from which it is

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gradually taken away to be weighed; an operation that may be performed on the cover or lid of the trough itself. It will easily be conceived, that if only one oven-full were to be made, or if, according to the method of some countries, a particular leaven were to be used for each oven-full, there would be no need of preserving a leaven which was not to be employed. It is likewise to be observed that the baker who possesses any knowledge of the flour he makes use of, and of the bread he wishes to make, can easily regulate, by the mere inspection of the dough, the number of turns necessary to obtain a favourable result from the roller. Nor is it less worthy of remark, that, towards the end of each turning, that is, when one side of the trough is on the point of being emptied, it will be always necessary to scrape, once with the hand-knife, the dough adhering to the partitions, and cast it, together with that which remains stationary at the bottom, under the roller, while revolving.

"The use of water rather warmer than usual is particularly recommended in order to raise the temperature of the roller; it being a good conductor of caloric or heat, it easily places itself in equilibrium with the surrounding air. In winter this precaution is indispensable. If notwithstanding this recommendation of adding rather a smaller, than a larger quantity of flour after diluting, it should be perceived that the dough is too firm, and that employment of more becomes necessary, it should be done by sprinkling the dough equally with a brush, as already directed and explained. As to the other parts of the process—namely, the quantity and degree of fermentation, and the space of time during which the dough is left to rise, they are to be conducted according to whatever system choice or locality may have established.

"It should not, however, be overlooked, that by the Petrisseur, or dough-kneading machine, the flour is better and more equally blended; and that each particle is placed in immediate contact with the water. Hence it not only imbibes all the water that is susceptible of absorbing, but requires more than mere manual labour could communicate to it. In this respect also the baker can easily determine the necessary increase.

"In short, the kneading of dough by the mechanical means under consideration, differs only from the ordinary process by being more *perfect*. For instead of blending flour by the uncertain and unequal arm of man, the uniform and steady action of the roller is substituted for that desirable purpose."

PLANETARY MACHINERY.

Sir,—Having observed in occasional numbers of the "Mechanics' Magazine," papers on the construction of planetary machinery, and therefore concluded that the subject is interesting to some of your readers, I send you a few condensed extracts from "Rees' Cyclopedia," and other works, which I made some years ago for my own private use, containing rules for calculating planetary trains.

H.

Rules for Calculating Planetary Trains in Astronomical Machinery.

General Rules and Observations.—1. In order to produce the greatest velocity with the fewest teeth, the ratio of each wheel to its pinion ought to be nearly as 36 to 10. 2. The driver is always the denominator of a fraction composed of a driver and a driven wheel or pinion. 3. When one wheel is fixed and the other in motion, the fixed wheel is the driver. 4. In every train of wheel-work, the wheels or pinions on the *first*, *third*, *fifth*, &c. arbors, all revolve in the same direction, and those on the *second*, *fourth*, *sixth*, &c., in a contrary. 5. When a wheel is added to change the direction, it is both a driver and driven, and therefore entirely omitted in computing the value of a train. 6. When a wheel or pinion revolves round the *outer* edge of a fixed wheel by means of a moveable bar, it turns in the *same* direction in which the bar itself moves; but when it revolves by means of connexion with the *inner* edge of a fixed ring, it revolves in a *contrary* direction. 7. The parallelism of a wheel's arbor, which is carried by a moveable arm round a central point, is preserved by means of *one* revolution of that wheel, in a direction *contrary* to that of the arm, in the *same time* that the arm is carried round.

The following rules must be observed in particular cases, and with the preceding contain all necessary information for the construction of general astronomical or rather planetarium machinery.

The simplest case is when a pinion is required to revolve any given num-

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ber of times for one revolution of its wheel.

Rule.—Fix upon a suitable number for the pinion, and by it multiply the given number of revolutions.

Example 1.

Number of revolutions required 10
Number chosen for the pinion 9
} × = 90 = the number of teeth for the required wheel.

Example 2.—Suppose the tropical revolution of a heavenly body revolving round the sun to be 243d. 11h. 52m. 32s., and that a pair of wheels be required to produce this revolution whilst the driver revolves in 365d. 5h. 48m. 48s. The simple fraction of these periods $\frac{21037952}{31556928}$, reduced to lower terms is $\frac{2}{3}, \frac{16}{24}, \frac{20}{30}$ &c.

Case 2. When the numbers are too large for single wheels, they must be resolved into their composite numbers, and a double pair formed.

Example. $\frac{629}{21} = \frac{37 \times 17}{7 \times 3}$ or $\frac{37}{7} \times \frac{17}{3}$; 3 being two small a number, the train must be $\frac{37}{7} \times \frac{34}{6}$.

Case 3.—When there is a great disparity between the numerator and denominator of a given fraction, and only the largest admits of composite numbers.

Rule.—Substitute 1 for a composite number along with the other, and then increase the parts as before.

Example. $\frac{19}{235} = 47 \times 5$ for which put 19×1.

Hence $\frac{19 \times 1}{47 \times 5}$ or $\frac{19}{47} \times \frac{1}{5}$ gives $\frac{19}{19} \times \frac{10}{50}$.

Instead of increasing both parts of the ratio as in the above examples, where 1 or 2, or some other number too low, stands in the place of a pinion, a single or double screw may be used with this limitation, that the screw be always the driver.

Case 4.—When an apparent *progressive* motion is to be produced by the difference of two comparative motions.

Rule.—Reduce the given period into its lowest denomination of time, and put it into a simple fraction in its lowest terms, which if the motion be *slower* than the period of which it is a fraction, will be an improper fraction: then let the numerator be the driven wheel, and the *difference* between the numerator and denominator, the driver.

Example.—Let $9\frac{5}{6}$ years be the period in which an index is required to advance progressively round the little ecliptic of an orrery, whilst the ecliptic moves backwards once a year; in the first place $9\frac{5}{6} = \frac{59}{6}$ which would be correct if the ecliptic was not on a revolving arbor, but in this case $\frac{59}{59-6}$ or $\frac{59}{53}$ will be the wheels required.

Case 5.—When an apparent *retrograde* motion is to be produced, proceed as before, except that the *sum* of the numerator and denominator must be the driver. The wheels in the above case would be $\frac{59}{59 \times 6} = \frac{59}{65}$.

Case 6.—When any given number of revolutions is to be produced in a wheel or pinion carried by a moveable arm during the time the arm is carried once round a central driving-wheel.

Rule.—A fraction consisting of the numbers of the two given wheels, whereof the central one must be the numerator, and the one driven by it on the bar the denominator, must be *added* to the required number of revolutions when the motions are in a *contrary*, and subtracted when in the same direction.

Example 1.

Teeth of the central wheel . . 15
Teeth of the wheel on the arm 10

and the direction the same: then let two such other wheels be required to be calcuated to actuate the central wheel, for the former portion of the train, as in addition to those two, will produce 15 revolutions of the wheel 10 while the arm goes once round. Then $15 - \frac{15}{10}$ or $1\frac{1}{2} = 13\frac{1}{2}$; in the next place, because the wheel of 15 goes only twice round for the wheel of 10, which is driven by it three times, $\frac{2}{3}$ or $\frac{10}{15}$ of $13\frac{1}{2} = 9$, is the value to be

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expressed by the fraction which is to represent the wheel and pinion required; therefore $\frac{12}{108}$, or any pair in similar ratio, will be the wheel and pinion required, and the whole value $\overline{\frac{12}{108}\times\frac{10}{15}}+\frac{15}{10}=15$.

Example 2.

Teeth of the wheels as before. The direction contrary.

$\frac{15}{10}=1\frac{1}{2}+15=16\frac{1}{2}$: then $\frac{10}{15}$ or $\frac{2}{3}$ of $16\frac{1}{2}$ $=11$ or $\frac{12}{132}$: whole value $\overline{\frac{12}{132}\times\frac{10}{15}}-\frac{15}{10}$ $=15$.

Here it appears that when a *negative* sign is prefixed to the fractional portion which consists of $\frac{\text{the central wheel}}{\text{the wheel on the arm}}$, in computing the number of revolutions made by the latter, a *positive* sign must be used for calculating the wheel work, and *vice versa*: also whenever the two wheels which compose the above fraction are of equal numbers, one must be invariably added or subtracted.

Table of Solar and Planetary Trains.

		D.	H.	′	″
☉	$\frac{49}{16}\times\frac{61}{13}$ ..... =	25	9	59	56.995
☉	$\frac{6}{101}\times\frac{41}{35}$ ..... =	25	10	0	4
☿	$\frac{11}{90}\times\frac{67}{34}\left(=\frac{35\times67}{102\times90}\right)$ ..... =	87	23	14	35.796
♀	$\frac{32}{113}\times\frac{63}{29}$ ..... =	224	16	43	1
⊕	$\frac{4}{227}\times\frac{17}{60}\times\frac{17}{31}$ or				
	$\frac{8}{227}\times\frac{17}{62}\times\frac{17}{60}$ ..... =	365	5	48	47.3
♂	$\frac{89}{25}\times\frac{28}{53}$ ..... =	686	22	29	41.19
	Vesta $\frac{106}{29}$ = 3.65517 years				
	Juno $\frac{135}{31}$ = 4.35484 years				
	Ceres and Pallas $\frac{138}{30}$				
♃	$\frac{111}{22}\times\frac{94}{40}$ ..... =	4330	14		
♄	$\frac{124}{7}\times\frac{98}{59}$ ..... =	10746	18		
♅	$\frac{67}{10}\times\frac{100}{8}$ ..... =	30589			

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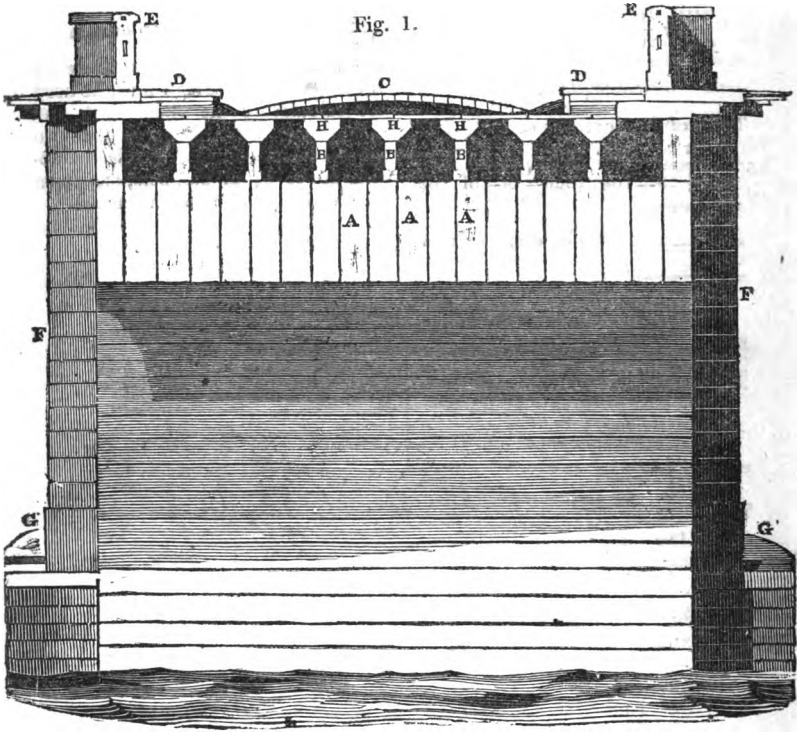
DESCRIPTIVE ACCOUNT OF THE PRINCIPAL BRIDGES ERECTED OVER THE RIVER THAMES. BY MR. C. DAVY, ARCHITECT.

No. XI.

Force exerted upon Centering—Construction of the New London Bridge, &c.

Fig. 1.



As centerings form the most expensive* species of mechanism in the construction of stone-bridges, it will be proper that we examine a little farther into their use. The immense extraneous weight, too, that they have to bear before the key-stone of the arch is fixed, renders the construction of them a matter of the first importance. All arches may be turned to the extent of 30° of inclination without any centre whatever, for the arch-stones or voussoirs at that angle will not slide on or from the position they are placed in—they merely press upon each other: but in proportion as the stones advance towards a perpendicular position, their sliding or gravitating force increases and acts in a powerful manner on the wooden framing. Hence in extensive centerings formed in two separate divisions the lowermost one performs the office of support to the upper and larger portion of the same. From these considerations it will appear, that according to the description of timber used in centre-framings, and the direction of force exerted upon it by the different arch-stones, we must, in order to determine the scantling of the timbers, find the amount of pressure required to crush timber of a given dimension and quality. Mr. Rennie carried his experi-

* The amount for fixing a framing of 3 sets of centres and extra materials at New London Bridge, was £13,421. 15*s.* 6*d.*

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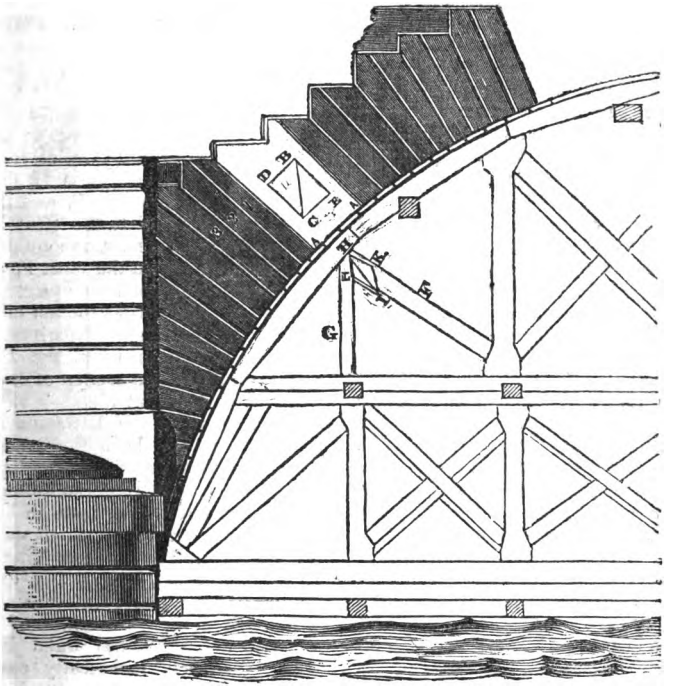
Fig. 2.



ments for this purpose to a very considerable extent; some of the results which apply immediately to our present purpose were as follows:—

		Crushing weight. lbs.
Elm	cubes of 1 inch.	1·284
White deal . .		1·928
English oak .		3·860

Prisms of seasoned oak, 2 inches square, and in height 2, 4, and 6 feet, were crushed by vertical pressures of 17,500, 10,500, and 7000lbs. If 4 inches square, and of the same altitudes, the following loads were required to crush them, viz. 80,000, 70,000, and 50,000lbs.; so that the nearer the wooden supports in the centre-framing approach to the perpendicular, the more weight they are capable of bearing. The centering of Waterloo Bridge was accordingly constructed by Mr. Rennie with a strict regard to this fact of the longitudinal incompressibility of timber. In the New London Bridge, however, tension is exerted as well, from the circumstance of a tie-beam being introduced. We may, on the whole, be warranted in coming to the following conclusions as to proceedings necessary to construct a centre:—

1st. The weight of each course of voussoirs pressing upon the centre during the building or turning of the arch, may be considered as commencing at an angle of 30°. At the same time it must be observed, that the actual weight of each stone must not be taken, part of the weight being transferred in a lateral direction, forming the thrust of the arch upon the piers. This force, therefore, falls to be deducted, leaving the sliding or gravitating force only that acts on the cen-

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tre. 2ndly. The framing must be so braced, that if one part or half of the arch is being turned without an equal proceeding of the other, the centre will not be distorted by such unequal pressure, nor the centre itself settle in the bed of the river. In the centering for the New London Bridge (see engraving in paper No. 9) this effect may be considered as partly counteracted by the *double* diagonal framing, for a slight inspection of the drawing will show that the weight of the arch-stones is distributed upon the queen-posts and one intervening strut or brace in each bay. Thus, on the right hand of the centre, the left hand braces with their queen-posts are operated upon, and *vice versa*. Now, if any force were exerted to sink the centre on one side into the bed of the river, the other braces would then be exceedingly serviceable: but place this circumstance out of the question, they are not of that utility which at first sight they appear to be. 3rdly. We must find the specific gravity of the *whole* mass of the sort of stone or material that is used, which will furnish a datum for the scantling of the beams, and finally fixing their relative disposition, by keeping in view the hints given in papers Nos. 9 and 10. To show the composition and resolution of these forces acting upon the centre, we may proceed as follows:—

Let the diagram, fig. 2, represent part of the centering and voussoirs of the arch, and let it be required to find, 1st, the pressure of the block or blocks of stone, exerted on the voussoirs, 1, 2, 3, &c., and the sliding-force of the same block exerted on the line AA of the voussoir 1. 2nd. To show in what proportion this latter force is transferred to the brace F and the upright post G.

For the first query, let us consider B as the centre of gravity of the whole mass, and the perpendicular line B+C, the weight of the mass =7 tons. From the point C draw CD parallel to the line of direction AA; and from the point B draw the line BD at right angles to that line; now draw BE parallel to DC, and CE parallel to DB, then will DB represent the pressing-force or thrust of the mass upon the stones 1, 2, 3, and BE will represent the sliding-force thrown upon the centering. This latter force is distributed upon the timbers as follows:—From the point of intersection of the timbers the line HI is drawn at the same angle of direction as BE and = in length; from the point I draw IK parallel to the upright post G; now from H make HK parallel to the strut F, and from I draw IL parallel to the strut F—then will HK represent the quantity of force acting upon the strut F, and HL the quantity upon the upright G.

The mechanical construction of the bridge itself is clearly explained by reference to the drawing, fig. 1; it exhibits a transverse section of one of the arches, taken at about ⅓ of the distance between the key-stone and the pier. It had been the practice till within these few years to adopt a certain mode of loading and filling up the spandrils of the arches with loose rubble-work, the use of which was to prevent the arch bursting or springing at the haunches; but as any extra weight at the crown would cause this to shift (from the loose nature of the materials), longitudinal walls have been introduced, technically called hance-walls, and their density and compactness renders them exceedingly firm and durable (see BB, fig. 1). On the top of these walls large blocks of stone H are bedded, and are again covered by heavy stone-landings, on which is laid a course of tarras or cement; on the top of this is the puddling for the roadway C; the other references will show E the parapet, D the pathway, AA voussoirs, F the piers, and G the cutwaters.

The construction of the coffer-dam will next occupy our attention.

(To be continued.)

THE CAMERA LUCIDA.

Sir,—In answer to the "Juvenile Reader," who requests "farther information" respecting the "Camera Lucida," I beg leave to inform him, that it is Dr. Wollaston's instrument which I recommended. Dr. Hooke's includes the convex lens, which, as I before stated, occasions inaccuracy and distortion.

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But I can scarcely comprehend how he should have misunderstood me, since I distinctly recollect having written "Hooke's Camera Lucida *as improved* by Dr. Wollaston;" and also as he appears to possess, or have access to, the Supplement to the "Encyclopedia Britannica," and must therefore have perceived that the plate and description of the instrument in that work bore a pretty strong resemblance to the drawing and description of it which I sent you. As well as I can recollect, indeed, the only difference between the representations was, that I turned mine the other way, because I find that your engravers *reverse* every thing, whereby even the threads of screws are made to twist in the wrong direction.*

This little inaccuracy is occasioned by their being copied directly from the drawing sent, instead of using a mirror: but still I cannot think that this could have occasioned the difficulty. I have no "farther information" to give respecting it, except it be to remark, that to those whose eyes are perfect, the two round lenses are useless, and the instrument may be had without them; and to those whose eyes are imperfect, I shall recommend that they turn their talents in another direction. But if your correspondent mean information respecting the effective *use* of the instrument, I can only reply, that the talent for delineation differs in no respect from other talents in being *innate*. That if he is naturally skilful, he will very soon learn to use the instrument to purpose, and will be much pleased with it. If otherwise, I can no more teach him how to produce a clever sketch, either with the Camera Lucida, or without it, than Sir Walter could teach him how to compose an ingenious poem or an interesting novel.

I remain, Sir,
Yours respectfully,
H. J.

Somerset Coffee-house, Strand.

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* I intend no *personal* reflection; the engraving in the "Encyclopedia" was executed in the same manner: and though it will, perhaps, by some, be scarcely credited, yet I assure you I have seen a battle-piece (and no such ill-done thing either), in which the warriors were made to wield the buckler in the right hand, and the sword in the left, from the same cause. Certainly it was an *old* engraving, and no such preposterous graphic delinquency is to be found in any modern work of the kind; but in my opinion, these less glaring errors are no less inexcusable. This digression I mean as a mild admonishment to engravers *in general*, and am in hope that (should you choose to print it), it may be the means of inducing them to

"Mend their line (or *lines*), and sin no more."

LONDON MECHANICS' INSTITUTION.—ADJOURNED GENERAL MEETING, 29th APRIL, 1830.

(From a Correspondent.)

The adjournment of the question respecting the Infidel and Radical meetings did not, as may readily be supposed, diminish the interest which the members took in its determination. The attendance was even more numerous than on the preceding evening, and the discussion, which was continued till midnight, equally angry and tempestuous. It would be out of the question to report any of the speeches made on an occasion, when, at times, every person was speaking; but some facts, which were elicited in the course of the debate, may be worth mentioning. It appeared from a statement read to the meeting by a Mr. Clarke, who said that he had drawn it up from the books of the institution, and the correctness of which statement no one offered to impugn, that all the money received for letting the theatre for political and irreligious purposes, amounted only to £233; but that so far from the institution being a gainer to that extent, it had lost considerably more by a contemporaneous falling off in the number of members and the amount of their subscriptions. The theatre first began to be let for such purposes in July 1828, and the sum received for members' subscriptions during the following year was £266 less than it had ever been in any preceding season! These facts produced, as they were well calculated to do, a strong impression on the meeting. On a show of hands being called, there appeared a great majority in favour of the resolution condemnatory of the use which has been made of the theatre. The committee party demanded a scrutiny, under the pretence that numbers had voted who

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were not members. A scrutiny was accordingly instituted, and such persons only allowed to vote as happened to have their member-tickets with them. Although this necessarily reduced the number of votes considerably, there still appeared a majority of more than a hundred in favour of the resolution. We regret to have to add that Mr. Owen, in his attempts to obtain a hearing, experienced a great deal of extremely coarse treatment. Mr. Owen may be wrong, but he has a title, at least, to the same courteous attention which he invariably extends to others. It is not by insolence and rudeness that the interests of truth are best vindicated and sustained.

We have been favoured by another correspondent with the statements alluded to in the preceding report as having been read by Mr. Clarke, and think them well worthy of being subjoined. No. 1 shows the gross receipts of the institution from all sources; members' subscriptions, donations, theatre-letting, &c. No. 2, the receipts from members alone—the only legitimate and wholesome source of revenue.

No. 1.

Gross Receipts per Quarter from 1825 *to* 1829, *both inclusive.*

Quarter ending	1825	1826	1827	1828	1829	1830
	£. s. d.	£. s. d.	£. s. d	£. s. d.	£. s. d.	£. s. d
March	550 0 0	535 12 4	519 8 8	535 9 0	462 8 0	428 11 8
June	1486 16 4 This includes 1000*l.* given by Sir F. Burdett.	506 11 7	460 0 8	468 15 9	370 17 6	
Sept.	559 6 1	308 9 1	458 4 9	331 15 3	334 17 6	
Dec.	566 16 1	385 19 0	482 7 3	386 8 0	322 9 3	
Total	3162 18 6	1736 12 0	1910 0 11	1722 8 0	1490 12 6 231*l.* less than was ever received in any former year	

No. 2.

Number of quarterly subscriptions paid by members in each year from 1825 to 1829, both inclusive.					Amounts received in members' subscriptions only in each year from 1825 to 1829, both inclusive.									
1825	1826	1827	1828	1829	1825			1826			1827			1828			1829		
					£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.
5555	5907	4897	4400	3714	1488	1	6	1405	13	0	1532	2	0	1458	16	0	1192	13	0

MR. VIGNOLES' TABLE OF THE POWERS OF LOCOMOTIVE-ENGINES ON RAILWAYS.

We have been favoured with a sight of an extremely valuable table of the powers of locomotive-engines on railways, of all degrees of inclination, which has been drawn up with great care and labour by Mr. Vignoles, the eminent engineer, for a work on railways, which, we are glad to learn, will be shortly forthcoming from his pen. It is too large to be conveniently transferred to our pages, but we subjoin a few of the principal columns of results. Mr. Vignoles, it may be proper to observe, assumes the friction to be equal to 10lbs. per ton, and the weight of the engine (tender included) to be 7½ tons; but there is abundant reason to believe that a considerable reduction in both respects is attainable, and in proportion to such reduction, the greater will be the load drawn in each instance.

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Table of the Gross Load which a Twenty-horse Locomotive-engine is capable of Drawing at different Velocities on a level Railway, and on an inclined plane of 1 *in* 90.*

Miles per hour.	Feet per min.	Gross load in tons on a level per horse power.	Total cylindrical power of a 20 horse engine.	
			Tons on a level.	On an inclination of 1 in 90
1	88	37·50	750·00	214·28
1½	132	25·00	500·00	142·86
2	176	18·75	375·00	107·14
2½	220	15·00	300·00	85·72
3	264	12·50	250·00	71·43
3½	308	10·71	214·29	61·22
4	352	9·38	187·50	53·57
4½	396	8·33	166·67	47·62
5	440	7·50	150·00	42·86
5½	484	6·82	136·36	38·96
6	528	6·52	125·00	35·71
6½	572	5·77	115·38	32·96
7	616	5·36	107·14	30·61
7½	660	5·00	100·00	28·58
8	704	4·69	93·75	26·79
8½	748	4·41	88·24	25·22
9	792	4·17	83·33	23·81
9½	836	3·95	78·95	22·56
10	880	3·75	75·00	21·43
10½	924	3·57	71·43	20·40
11	968	3·41	68·18	19·48
11½	1012	3·26	65·22	18·64
12	1056	3·13	62·50	17·86
12½	1100	3·00	60·00	17·14
13	1144	2·88	57·69	16·48
13½	1188	2·78	55·56	15·88
14	1232	2·68	53·57	15·30
14½	1276	2·59	51·72	14·78
15	1320	2·50	50·00	14·29
15½	1364	2·42	48·39	13·82
16	1408	2·34	46·88	13·39
16½	1452	2·27	45·45	12·98
17	1496	2·21	44·12	12·61
17½	1540	2·14	42·86	12·24
18	1584	2·08	41·67	11·90
18½	1628	2·03	40·54	11·58
19	1672	1·97	39·47	11·28
19½	1716	1·92	38·46	10·98
20	1760	1·88	37·50	10·71
25	2200	1·50	30·00	8·57
30	2640	1·25	25·00	7·14
37½	3300	1·00	20·00	5·72
40	3520	0·94	18·75	5·36

* About equal to the rise on the Commercial-road, between Three Colt-street and Limehouse Bridge. See section of that road, page 79 of our present volume.

MR. GILMAN'S EXPLANATION.

Mr. Editor,—I cannot feel much surprised at the soreness which the friends of Mr. Hall have displayed since the publication of my narrative, after the coincidence of circumstances which it has been the cause of disclosing. On this account I can forgive the warm ebullition of feeling they have manifested, and am only desirous in return that my expressions should be treated with candour and fairness, when I am sure that scarcely one of the assertions that have been made by them can be justified.

I was not aware that any thing I have described as having been done in "1826," clashed in the smallest degree with Mr. Hall's patent of "1828," previous to the appearance of Mr. Syngleman's extract in the 346th Number, and therefore it could not have been propounded with any design to injure him. The existence of this patent, however, removes the chief obstacles that stood in the way of explanation as to the *real* origin of the generator in dispute, because there can now be no private property endangered, as regards *any* of the plans from whence it emanated, and those plans may fairly now become a matter of history. But notwithstanding this, and that my defence demands such a step, still I must confess I feel a considerable degree of reluctance to proceed, because my explanation will oblige me to give the names of gentlemen whom I have no desire to subject to the illiberal and unfounded imputations and remarks which have been so freely meted out to me.

However I am constrained to state that in the month of August, "1825," I became acquainted with Mr. Pearson, who intimated to me that himself and a friend had some improvements in view relative to steam, and as I had some improvements also—those which are given as the two last modifications—it was ultimately agreed to proceed in conjunction. About Christmas in that year, Mr. Pearson introduced me to his friend, who had just arrived from his residence in the country, and who proved to be Mr. R. Witty, a respectable engineer, and, I believe, a very ingenious and worthy man, whom I never saw (as I have elsewhere remarked), but on that one occasion, when a developement of our views took place. The plan those gentlemen proposed was briefly this:—To effect combustion under pressure, and to mix the products arising therefrom with the steam generated from water, by which the fire was to be

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surrounded. Now, Mr. Editor, this is precisely "Mr. Hall's plan of 1823," with the exception of no steam being passed through the fuel; and this plan existed, to my knowledge, in August "1825." I have every reason, too, to believe that it did exist long before that time.

The plans which I proposed were those of the two last modifications; namely, first to excite the fire by means of a blast, and to cause the flue to terminate in a cistern or vessel of water in order to the retention of the carbonacious and other ponderable matter, by which a chimney would be rendered unnecessary, and that nuisance, smoke, got rid of; and second, to procure a draft by connecting an exhausting apparatus to the cistern or vessel above the surface of the water, in which a flue might terminate, and thus the necessity for a chimney be also done away.

From the plans thus proposed, originated the apparatus of "1826," of which my narrative gives a general, though a correct account, and not from any thing that Mr. Hall, or either of the Mr. Halls, have done, as regards either of the plans or apparatus, notwithstanding all the logical quibbling that has been resorted to in support of the contrary, and which, by-the-bye, requires no refutation, as it conveys its own antidote. I have no reason to believe—on the contrary, I have every reason to disbelieve—that either Mr. Pearson or Mr. Witty had any knowledge whatever of Mr. Hall's proceedings; but supposing they had, I have before shown in my replies to Mr. Syngleman that the two objects were perfectly dissimilar. Mr. Butler, too, in the last Number, page 134, has *acknowledged* that the plan patented in "1824" was for the purpose of "*decomposing steam*," as I stated it to be in the above-mentioned replies; and I maintain that there is not the most distant hint in the patent of "1824," that Mr. Hall contemplated any such object as the one described in his patent of "1828," though Mr. Syngleman has asserted the contrary.

What Mr. Butler states to have been done by Mr. Hall, previous to the patent of "1828" being sealed, I have no desire to controvert, or in any way question. It only tends to prove what Mr. Hall did—not that any other person could not, and may not have done the like; though the general character of his reasoning goes far to promulgate this monstrous doctrine that no person could conceive the idea, or prosecute it, but Mr. Hall, whence he proceeds to the conclusion that Mr. Hall's plan and apparatus must necessarily have been pirated. I know nothing of Mr. Hall, or his connexions, and as nothing could be known of the plan which that gentleman had in secret until his patent of "1828" was sealed (otherwise he would not have been entitled to a patent), I think I might retort the charge of plagiarism, with at least equal justice, were I so inclined.

The explanation of Mr. Butler has brought to light a curious coincidence of time and circumstance, and the affair is, no doubt, unpalatable and vexatious to Mr. Hall; but such coincidence by no means warrants the extraordinary conclusions of Mr. Butler, nor the "indecent" (to use his own phrase) remarks *he* has made.

As regards the generator, the chief things that it possesses, in common with Mr. Hall's, is, that it has one cylinder within another. Now, Mr. Editor, I could name half a dozen plans that agree to this extent, contrived by different individuals. The charge of imitation, however, is unworthy of notice, as is likewise the assertion respecting the capability of the generator to accomplish the object proposed; for the contrary could be proved, were it necessary, notwithstanding *all* the *assertions* that have been made. But as the apparatus was given *only* for the purpose of explaining the plan proceeded upon, and was constructed for a compound of purposes, and not for this one exclusively, and consequently not to be followed in every particular, if followed at all, I shall not enter into any controversy on the subject.

The only thing for me to notice is Mr. Butler's last paragraph but one, wherein he observes that "nothing can show more fully how little Mr. Gilman really knows of the principle and apparatus he has pretended to have discovered and invented, than his statement that the artificial atmosphere might be produced as beneficially (if not more so) by an exhausting, as by a forcing apparatus, &c." Now, Mr. Editor, I should be glad to be informed as to who ever proposed to produce an artificial atmosphere by exhaustion; or, indeed, who ever proposed to work an engine by a mixture of atmospheric air, or, rather, the nitrogen of the atmosphere and steam, from either of the two last modifications. For a certainty I never did, nor could any person understand either my narrative or explanation to imply any such absurdity. You, by your remarks in the 331st number, page 287, did not

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so understand it, nor is there any thing to be found to warrant such a conclusion.

The explanation I have given relative to the origin of the generator of "1826," will show the cause why the two last modifications existed before that apparatus was projected.

I am, Sir,
Yours, &c.
WM. GILMAN.

May 1, 1830.

REPLY BY S. Y. TO A PRACTICAL ENGINEER.

Sir,—My question to A Practical Engineer was *not* "how Mr. Gilman's joints might be made without turning," but how the faces were to be brought as *near together* as described by that gentleman, without being turned; and he sagaciously answers, by being kept *farther apart*. Truly this is a most *valuable* piece of information, and I return him due thanks for it. He admits that it might be necessary to turn the joints "*roughly*," but raises all this controversy, and concludes that the description of the joints is false, because Mr. G. happened to say they were "*accurately* turned and nicely faced to fit each other." Is it possible for Mr. G. or any one else to write so as to satisfy such a caviller about trifles?

I did not *withhold* the context, but I quoted from A Practical Engineer's paper, in which I do not think it appears; but after all it does not prove the joints were not made in the manner described.

If a safety valve is loaded with 60 pounds on the inch, it will retain the steam until its pressure just exceeds 60 pounds on the inch. If it is loaded with ten times the weight, it will retain steam of ten times the pressure. The joint of the valve is formed by two metallic surfaces which fit each other, being compressed together, which may be done by a weight, a spring, a screw, &c. &c.; and Mr. Gilman's joints are so far of the same description. Now, if the weight is to be removed and the valve held down by bolts instead, is there any difficulty in finding the area of those bolts? Certainly not. There is, however, a difference in the joints and the valve (which I have explained in the enclosed note),* which requires the bolts to be stronger than this calculation would make them; but I distinctly deny that they require to be of *double* that strength, or that the difference renders the calculation in the least difficult. That Mr. Practical is deeply skilled in the profound mysteries of making joints I have no doubt, and being so, I hope he will inform us WHY "double, treble, or quadruple that pressure will not be sufficient;" and if he does *not* do so, I must conclude the assertion is one of those tricks of which men who argue for the sake of victory, and not for the sake of truth, are too fond of availing themselves.

I beg Mr. Practical's pardon for contradicting him, but there cannot possibly be any inconsistency "in my account of the bolts," for this very sufficient reason, *that I gave no account of them whatever*. What I said about them was, that their strength and fitness should be estimated from their area as given by Mr. Gilman, and not from a drawing, which in all probability was not intended to give their sizes.

As to Mr. Horn's name being introduced by Mr. Gilman to *prove* a fact asserted by his *opponents* and *admitted by himself*, it is ridiculous to suppose it.

S. Y. put no "queries" to A Practical Engineer, save the one named at the beginning of this paper; he said that if A Practical Engineer acted in a certain manner, all reasonable men would inevitably form opinions of him not particularly creditable. S. Y. *does not know any thing of* Mr. Gilman; much less are they the same individual.

S. Y. informs Mr. Peter Pindar that he humbly conceives if a man, whether a scientific man or not, had occasion for a drawing to elucidate the manner in which a principle was applied, and happened to be a man of sense, he would make use of as simple a diagram as possible, and not crowd the figure with parts which it was not necessary to describe, merely for the sake of making it more complicated. But this is a mere matter of opinion.

I am certainly neither a "concealed enemy" nor "pretended friend" to Mr. Gilman; but a true friend to truth and *fair* discussion. All my observations apply to the reasoning of the parties, and not to the merits of the invention; and I must say the reasoning of A Practical Engineer does *not* seem to *me* to tend to "*putting a fair construction on Mr. Gilman's statements*," or any thing like it.

I must take the liberty of saying, Sir, that I think *opinions of an individual at*

* Not intended for publication at present.—ED. M. M.

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Manchester, &c., would have been a more fit heading for P. P.'s letter; for although he speaks of himself and "many others," yet we know nothing of them, and perhaps if we did, we should find their opinions of no very great consequence.

I wish I could spare the time necessary to examine, critically, the whole of this correspondence; when I have no doubt, many mighty matters in dispute would prove of about as much importance, as the difference between turning the joints "*roughly*" and "*accurately*."

I will conclude by asking Mr. Gilman whether he had not better "prove" what a Practical Engineer challenges him to prove, page 117, or give satisfactory reasons for not doing so, and thus end the dispute?

Yours respectfully,

S. Y. an Engineer.

April 24, 1830.

MISCELLANEOUS.

March of Improvement in America.—When the project of a canal between Erie and the Hudson was first communicated by Judge Forman to Mr. Jefferson, the latter replied—"It is a very fine project, and may be erected *a century hence*. You talk of making a canal two hundred and fifty miles through a wilderness! It is little short of madness to think of it at this day." This was in 1809. Mr. Jefferson lived to see the project completed. The canal was not, indeed, made through a wilderness, for that wilderness had become, in a short time, one of the most remarkable examples of human industry to be found in the world. Mr. Jefferson is reported to have observed on a subsequent occasion—"I once said the project of this canal was a century too soon, but I am now convinced I was a century behind a just estimate of the march of improvement in this country." When the act for the formation of this canal passed, it was estimated that the traffic upon it would not, for some years, exceed 200,000 tons, but the very first year it was opened, the amount was upwards of 600,000 tons.

Decimal System.—"The Canadian legislature adopted, last month, the monetary part of the decimal system of account inserted in the *Mechanics' Magazine*, Nos. 315—318. (See *Times* and *Herald*, April 22.) *The Times* of the 26th April reports the value of the Chinese tale to be 1-8th less than 6-8ths. It was so valued in the *Mechanics' Magazine*, No. 334."—T.

Melancholy End of an Inventor.—On the 23rd of January last, a patent was taken out by Mr. George Vaughan, of Cleveland-street, Mile-end-road, for a new machine for raising water. On the 20th of March he lodged his specification; and on Saturday last, the 1st of May, he proceeded to make trial of a machine which he had just then completed according to the plan specified, when, not finding it to come up to his expectations, he retired to his room, and in a fit of despair, destroyed himself. Had the state of our patent-laws been such as to admit of Mr. Vaughan's safely making that trial, in the first instance, which brought with it, in the eleventh hour, so overwhelming a sense of loss and disappointment, it is more than probable that a valuable life might have been spared to the community.

Cables and Launches.—The Hon. Captain G. Elliott has invented a connecting shackle for joining the ends of an iron and hempen cable, by which the tedious and unsafe process of joining them by the tails of the latter is avoided. Experiments have been made on Captain Elliott's invention, which have established its superiority; and we hear that it will be generally adopted. Captain Elliott has also suggested a method of fitting the launch of a ship in a manner that will enable her to carry out her best bower anchor, without any previous preparation, and so that it will not interfere, in any manner, with the ordinary duties of the boat.—*United Service Journal, for May*, 1830.

Canterbury and Whitstable Rail-road.—On Monday last, this rail-road was opened for public traffic. It is between six and seven miles in length, and has been five years in progress. For the first four miles it proceeds on an inclination of 1 in 90, down which waggons proceed, by the force of their own gravity, at the rate of 25 miles an hour. The rest of the railway is nearly level, and here locomotive steam-engines are made use of. At one part there is a tunnel 822 yards in length, carried through the Brethren Hills. The immense advantages which this district will derive from this railway may be anticipated, from the circumstance that coals alone will experience a reduction of sixpence a chaldron for carriage. Passengers will also be conveyed for sixpence or ninepence per head in twenty minutes.—*Abridged from the Morning Herald.* We shall be glad to receive from some of our Kentish friends a more particular account of this railway.

Sailing on Land.—A sail was set on a car on our rail-road, yesterday afternoon, in the presence of a large concourse of spectators. Fifteen gentlemen got on board, and flew off at the rate of twelve to fourteen miles an hour. Thirteen persons and three tons of iron were carried about ten miles an hour. When going at the rate of about twelve miles an hour, and loaded with fifteen passengers, the mast went by the board, with the sail and rigging attached, carrying with them several of the crew. The wreck was descried by several friendly ship-masters, who kindly rendered assistance in rigging a jury-mast, and the car was soon again put under weigh. During the afternoon the wind changed so as to bring it nearly a-head, when going in one direction; but this did not stop the sport as it was ascertained that the car would sail within four points of the wind.—*Charleston (U. S.) Courier, of 20th March.*

INTERIM NOTICES.

"Fabricius" asks "Why Mr. Lennard has not revived the committee on the Patent-Laws?" This is a question which every body interested in the subject has been asking for these three months. If Mr. Lennard does not bestir himself, he may have more deaths than that of poor Vaughan, (recorded among our Miscellaneous Notices), to answer for.

S. Y. and the Correspondent who favoured us with the "English Decimal Account," are requested to send to our office for letters addressed to them.

Communications received from H. H.—A Member—Mr. Davy—R. O. A.—Iskimber—L. L.—Mr. Peacock—P. P.—Mr. M'Duff—M: W.—T. M. B.—Mr. Utting—J. G. N.

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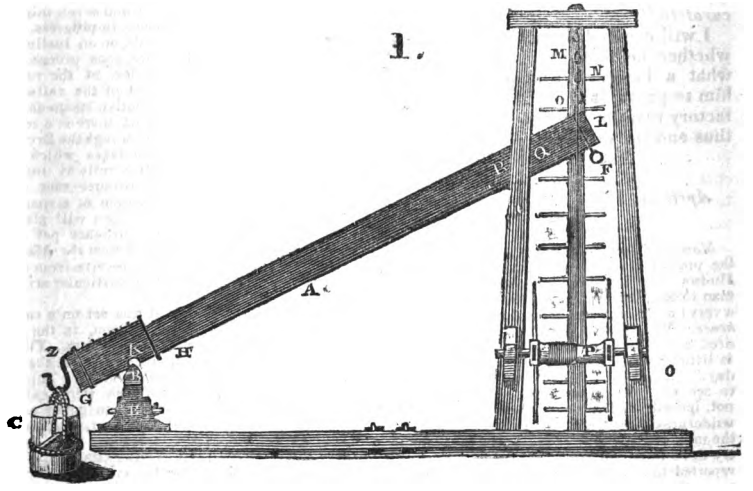
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 353.] SATURDAY, MAY 15, 1830. [Price 3*d*.

PILE-WITHDRAWING MACHINERY.

1.



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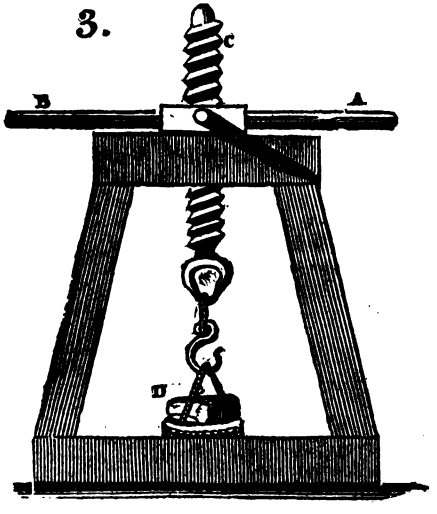

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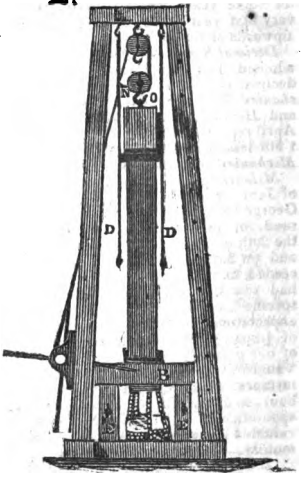

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DESCRIPTIVE ACCOUNT OF THE PRINCIPAL BRIDGES ERECTED OVER THE RIVER THAMES. BY MR. C. DAVY, ARCHITECT.

No. XII.

Pile-withdrawing Machinery.

The operation of piling requires so much heavy timber, and is withal of so expensive a nature, that effective machinery for withdrawing piles from the bed of rivers is a great desideratum. The timber may afterwards be employed in farther service, or in works of the same description. Marshal Belleisle, in 1747, passed the Var to the army of the Allies for the purpose of conquering an adjacent province (Nice); and to facilitate the communication with France, he caused to be constructed across that river two magnificent bridges, measuring in length about 300 toises each, and of sufficient solidity to resist the force of one of the strongest currents in Europe, at a time, too, when the river was most subject to them. When the evacuation took place in 1749, the bridges were destroyed. The foundations, to use the words of M. Belidor, comprised a "forest of piles." This writer communicated to M. Guil, Brigadier-general of the King's army, the design of the machines shown in figs. 1 and 2, as it was deemed necessary to withdraw the whole of the piles, many of which were buried at the depth of 12, 13, and 15 feet in the bed of the river, and in an extremely tenacious earth. After repeated trials to no effect, arising from the cords breaking, they employed nine to each machine, and the piles were then drawn with surprising expedition, each in less than four or five minutes.* The general construction of this machine is explained by figs. 1 and 2, which require but little explanation. A beam GL is placed upon a support or fulcrum B; the end of the beam G is bound with iron straps, having a hook Z to lay hold of the cord or chain which is fastened to the pile C, by means of a short bar or rod of iron driven through the pile; the beam is elevated for this purpose by the windlass P, and when made fast at one end (Z) is released at L; consequently the beam is allowed to fall by its own gravity, drawing the pile C upwards. The length of the beam, in this case, is supposed to be 18 feet, and the length GK 2 feet; but in all cases, whatever the length of the beam may be, divide the same into 9 equal parts, and allow one part for the length from the extremity to the fulcrum at K. The action of the apparatus may be rendered more powerful by the workmen mounting upon the end L, and thrusting it downwards. The substance of M. Belidor's calculation of the power of this machine is as follows:—Let us suppose the beam to be 18 feet long and 12 in. × 12 in. and, as we have before stated, GK will be 2 feet long, and KL 16 feet in length. I shall add that the cubic foot of dry oak weighs about 60lbs.; and let us take this as the ground-work of the calculation we are about to make. For greater precision, make KH=GK in order to consider these two parts of the beams as being equilibrated. Now, imagine that the rest of the weight HL is united in the middle A, the centre of gravity of the part HL to take the place of the power which is to act upon the pile: recollecting that this power will be 840lbs. which is the weight of 14 cubic feet of dry oak, answering to the arm of the lever KA 9 feet; whilst the other KG, in regard to its effect, is only 2 feet. Thus, in the state of equilibrium, the power A of 840lbs. will be to its action in drawing the pile as KG is to KA, or as 2 is to 9. Following the rule, we shall find that this action=3780lbs. which can be augmented by the thrusts that the workmen mounted upon the end RL will give to it. If we suppose 4 men acting together by supporting themselves by the cords DD, fig. 2, suspended from the top of the machine to prevent them falling; it will appear, that weighing together 600lbs. at the extremity of the lever KQ, which is equal 6 times KG, their effect upon the pile will be 3600lbs. which added to 3780, gives 7380lbs. for the force with which the pile C will be drawn upwards. The power of the machine may again be prodigiously augmented should the pile refuse to move from these exertions.

* Belidor Architecture Hydraulique, vol. i, Lecture I. p. 121, 22.

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Displace the pullies from their position MN, and fix a ring F to the end of the beam, which will be kept raised by the hook Z laying hold of the chain or rope attached to the pile: a pulley is then fixed at the foot of the machine, and a cord or rope passed through the ring F and the pulley at the bottom; the workmen will then pull horizontally at the bottom, and draw the beam downwards with great power.

This machine may be also made to answer the purpose of the ordinary pile-machine, by fixing a heavy ram at one end; it is then raised and allowed to fall, as usual, or might be worked after the manner of a tilt hammer.

Fig. 3 is another apparatus for withdrawing piling; C is a screw supported in a square timber framing, worked with the levers BA in the manner of a capstan. The pile D is attached to the hook at the bottom by cords or chains, and is, of course, drawn upwards. This may be called a flying-machine, as it may be rapidly moved by boats from one place to another. Its principal defect is, that if the pile is very firmly fixed, the stand will not remain sufficiently steady for the purpose of its operation.

(To be continued.)

DRURY'S PLAN OF BELL-RINGING.

Sir,—The design for a bell-tower, given in the front-page of your 342nd Number, with the figure of a man ringing one of the bells by a hammer fixed on Mr. Drury's plan, does truly exhibit what must needs be the case should this project be applied to any peal of church-bells. The man is represented as pulling with such force as to endanger the breaking of the bell, and apparently with much greater force than would suffice to ring a large bell hung in the modern manner.*

Not only, however, does this particular mode of fixing the hammers conduce greatly to endanger the bells, but there seems to be scarcely any possibility of striking moderate and equal blows at the same time. It requires a certain force merely to raise the hammer just up to the bell without striking it at all; and it is easy to conceive that an addition to that force, although so small as to be almost imperceptible to the person giving it, might cause a pretty smart blow. It is evident, also, that it will be much less difficult to strike hard blows than moderate ones. It is known, however, that bells require only moderate blows; and as the effect of any variation in the force applied to a hammer so fixed and swinging in so large a range, is clearly such as to render it a ticklish matter to avoid either striking the bell immoderately hard or not at all, there perhaps might be some difficulty in devising a plan that would more effectually prevent regular blows from being given. Consequently, were the mode of ringing bells by hammers to be really thought desirable, this manner of fixing them (which has also been shown in some former Numbers of your Magazine), in which the most violent blows might be given at the caprice of the individual, and in which the difficulty of striking suitable blows is so great, would certainly not be that which would be generally adopted; but rather that the means which has occasionally been resorted to "time out of mind" would be considered greatly preferable. It scarcely need be said that I allude to what is technically called "tolling-hammers;" which being fixed a good deal similar to church-clock hammers, admit of being pulled only to a limited height, from whence they fall and strike regular blows on the bells. Of course, the blows of these hammers can never be greater than they are adapted to give; and being suited to the size of the bells, their full sounds are produced at the same time that the bells are exposed to no greater jeopardy than when hung and rung in the usual manner. This new scheme, therefore, ought to have been called "Mr. Drury's plan," and certainly not his "improvement."

JAMES HARRISON.

Barton-upon-Humber,
March 9, 1830.

* It is but fair to state, that the correspondent who favoured us with the design alluded to is not responsible for the part which this ringing-figure *plays* in the business; the addition of a man to the rope being a conceit of our draughtsman, who thought (oddly enough) that it would give a little more *life* to the scene.—Ed. M. M.

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QUADRATURE OF THE CIRCLE.

Sir,—Your correspondent, Amicus, invites the opinion of others of your correspondents on the value of a computative and a mechanical method of squaring the circle, which he received from Major-general Ouseley. I trust it will not be deemed rude or offensive, if an obscure individual like myself venture to propose a test by which the value of such contrivances may be measured upon the scale of their actual utility.

In No. 317, your correspondent, O. C. F., described a construction by a Mr. Sankey, which is strictly geometrical, and approximative to any degree of accuracy we please; and your correspondent deduced from it a computation by the secants, which may also be extended to any degree of accuracy. There the utility was obvious, and the facility and accuracy could at once be ascertained.

Now, with regard to General Ouseley's method of squaring the circle by a rolling cylinder, it is evidently mechanical; and, though really ingenious, subject to the defects of a mechanical method. How are we to know *precisely* when the right line upon the curve surface of the cylinder, which was first in contact with the plane surface, comes into contact with it again?

As to the computative method, to me it seems very correct as an approximation, but presenting no advantage in practice. What are we to do, in using it? After squaring that diameter, we are to take $\frac{1}{4}$ of that square; then we are to take $\frac{4}{113}$ of that square, and add to the former result. But dividing by 113 to 6 or 7 places of decimals, is a comparatively tedious operation. A computer would much rather multiply by ·785398, than have to perform these two operations. Then, "where's the good?"

In the approximative rules that are usually given by mathematicians, they have, or ought to have, an eye to practical facility; and thus it is if we find the area by taking $\frac{1}{88}$ of the square of the *circumference*. We multiply that square by 7 in one line, and divide by 88 in two lines more, dividing successively (in short division), by the component factors, 8 and 11. So again, if we take $\frac{11}{14}\,d^2$, for an approximation to the area, there is no long division, but two short divisions by the factors 2 and 7 of 14.

Indeed, it is by no means difficult to approximate considerably, by two or three successive divisions and additions; yet the methods seldom answer better in practice than multiplying at once by the proper decimal multiplier. One of the best approximative methods is perhaps the following:—Take $\frac{7}{9}$ of the square of the *diameter*, add to it its hundredth part, and subtract from that sum its 5000th part; the remainder will be the area, very nearly.

Suppose the diameter to be 25, its square 625:

Then		625
Multiplied by		7
Divided by	9)	4375
The seven-ninths . . .		486·111111
+ their 100th part . . .		4·861111
		490·972222
—the 5000th part of the sum		·098194
		490·874028

Here each line is obtained at once by a short multiplication or division, and the result approximates nearly to the result 490·87385, obtained by multiplying the square of the diameter by ·78539816. I confess, however, that even here, I should prefer the correct to the approximative method

If this letter is not already becom-

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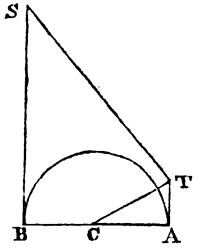
ing too long, I would venture to add to the variety of approximating constructions which are to be found in your Magazine, one, which, though I do not apprehend it is new, is but very little known.



Let AB be the diameter of a semi-circle. At one extremity, A, erect a perpendicular AS equal to three times the radius AC; and at the other extremity, another perpendicular, BT, equal to the tangent of 30°. Join ST; it shall be very nearly equal to the semi-circumference. And the rectangle of the radius into the semi-circumference, is, as is well known, equal to the area of the circle.

The semi-circumference found thus, is true within its *fifty-thousandth* part; that is, *theoretically* true; but this is far within the practical limits of any construction, however carefully executed. I leave the proof of the limits here assigned as an exercise to your younger readers; and am, Sir,

Yours, &c.

April 27, 1830. CUI BONO?

SQUARING THE CIRCLE.

Sir,—In No. 350 of the "Mechanics' Magazine," you have inserted a paper by Amicus, pointing out a supposed discovery made by Major-general Ouseley of new approximate methods of finding the area of a circle, one of which is the following, viz. $\left(\frac{4}{113}+\frac{3}{4}\right)$ d^2 = area of the circle nearly.

Now $\frac{4}{113}+\frac{3}{4}=\frac{16}{452}+\frac{339}{452}$ ∴ their sum $=\frac{355}{452}$* $=$ ·785398, true to six decimal places.

The following formula I find, however, approximates much nearer the truth; viz. $-\left(\frac{355}{452}-\frac{1}{15000000}\right)d^2$.

Example.

$$\frac{355}{452} = \cdot 7853982301$$

$$\frac{1}{15000000} - \cdot 0000000667$$

Their difference $=$ ·7853981634 $=$ *area* of a circle to diameter unity; this multiplied by 4 gives the *circumference* $=3{\cdot}1415926536$, both of which are true in all their places, or to ten places of decimals; this result is, I presume, deduced with less labour than by any other approximate method at present known.

In respect to the geometrical construction of the General's, it is well known that the circumference of a circle, multiplied by $\frac{1}{4}$ of its diameter, is equal to its area. Hence it is evident that the square root of the rectangle, generated by the General's method, is equal to the side of a square, whose area is equal to that of each end of the cylinder; and which is also equal to its convex superficies. But previous to the area, the length of this rectangle, or circumference of the cylinder must be obtained, which may be effected as follows.

Suppose a metallic cylinder, whose length is equal to $\frac{1}{4}$ of its diameter, to be truly turned, and a fine line to be engraved on its convex superficies perpendicular to the planes of the ends of the cylinder.

Now if the convex surface of the cylinder be supplied with printers' ink, and the cylinder be made to roll on a sheet of white paper, the superficies of the cylinder will be thus transferred to the paper, leaving a fine white line at the completion of each revolution of the cylinder. These revolutions may be repeated as many times as we please; and thus by taking the mean length by a correct scale, a very near approximation to the circumference of a circle may be obtained, the diameter being already known.

This construction, however, I should think, may be more aptly designated a

* Derived from $\frac{355}{113}$, the well-known approximate value of the circumference of a circle to diameter unity; the denominator 113 being multiplied by 4 to express the value of the *area* of the circle, instead of that of its circumference. This approximation of the General's, therefore, resolves itself into one already well known, and which is given in most treatises on arithmetic.

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geometric mechanical construction, rather than a purely geometrical one.

I am, Sir,
Yours, &c.
J. UTTING.

Lynn Regis, April 28, 1830.

[We had also given out for insertion a communication on the same subject from M. W., but it has been accidentally excluded by the Printer in the making up of the sheet. It shall appear in our next.—ED. M. M.]

INVOLUTE AND EPICYCLOIDAL TEETH.

Sir,—I consider it somewhat *mal-a-propos*, that your correspondent "S.Y." (an engineer) should disclaim "presuming on what he has seen in print," and at the same time refer to Drs. Gregory, Robison, and Rees, as authority for what he asserts (see No. 334, page 22). However

"'Tis not *antiquity*, nor *author*,
That makes truth truth, altho' *Time's* daughter."

Whether the authorities referred to are greater theorists than I am, is of no importance whatever, nor has it any thing to do with the matter at issue. And as to "S. Y." observing that those *authors* "condescend to give their readers some proof of what they assert," I may remark that those gentlemen are not the authors of *involute* teeth. I believe the idea of forming the teeth of wheels by involutes of their circles, originated with Mons. De la Hire; his description thereof was published many years ago. But so far from involute teeth having no slide, it is easy to show that they have *a greater slide*, and at the same time *press harder* than epicycloidal teeth in producing the same effect; whence their *friction* and *wear* must needs be considerably greater. They not merely slide the whole distance the circles advance and recede in their arcs of contact, but they slide by the circuitous course of the surfaces of the teeth, which being more oblique, is consequently greater in proportion to their direct length than epicycloidal teeth. Then as to the pressure—it scarcely need be said that it is inevitably greater in proportion as its direction is more oblique to the motion it imparts; and it also throws *a much greater pressure upon the gudgeons, tending to force the centres of the wheels farther asunder.* I know an instance of two wheels in a large water-mill, the teeth of which were formed by their respective involutes: these wheels belonged to a part of the machinery upon which the press of the work was very considerable, and one of them being small, occasioned so heavy a press on the gudgeons as to make it necessary to introduce a much stronger beam to secure the wheel from forcing out of geer. This single trial convinced the artist that although *practice will not point out the true form of teeth*, yet it will point out a much better form than involutes of the circles; and I presume that "mathematical investigation" has not shown "S. Y." that teeth formed by this curve do not slide.

That the convex sides of two circles can only coincide in one point, and that they recede from each other in an increasing ratio as the distance from that point increases, is so very obvious, that it is wonderful the idea of the teeth of wheels *rolling through each other without friction* should have been conceived; and it is quite evident that *no form whatever that can be given to the teeth of wheels can prevent their sliding against each other.*

But "S. Y." wishes for proof, and accordingly my son has chosen to gratify his desire by giving him the best of all proofs, *namely*, a model with *involute teeth.* It accompanies the present paper to the Mechanics' Magazine Office; and though rudely thrown together, *it is well adapted to show the sliding of the teeth of two wheels in action.* If "S. Y.'s" residence should be at such a distance from London as to make it inconvenient for him to see it, undoubtedly the editor will satisfy him by his report, especially as such report is necessary for general readers, it being obvious that whatever has a tendency to mislead, ought to be followed by its antidote. The model shows that the

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sliding of the teeth is greater and greater as the distance from the coinciding point or line of centres increases.

"S. Y." observes, that *I have charged epicycloidal teeth with about twice as much friction as they are answerable for*, and to this I readily assent. Instead of saying (No. 336, page 363), "the driving-wheel continuing to press the other wheel forward through all angles comprised between the point where the teeth enters in to that where they come out;" I ought to have said, *all angles comprised between the point where the contact of the teeth begins to that where it ends.* But "S. Y." is in error by supposing that the teeth of both wheels pass over the line *c d* in the same direction; as "an engineer," he ought to have *known* that the wheels move in *circles*, and that *c d* is *a straight line!* It is strange that "an engineer" could not perceive so plain a fact.

As to the quotation from "Robison's Mechanical Philosophy," viz. "The whole slide of a tooth, three inches long, belonging to a wheel ten feet diameter, acting on a tooth of a wheel two feet diameter, does not amount to 1-60th of an inch;" I have only to say, that although this assertion may have served "young" "S. Y." (or any other person who did not know better) to square his ideas by, yet it is not true in fact. The arcs through which the contact of the teeth are continued, appear to be such as to recede from each other not less than fifteen times the above-mentioned quantity; and just so far do the teeth *go in* and *come out* during their contact. And if to this we add the increase occasioned by *the obliquity* and by *the curvity* of the teeth, the whole may amount to about one-third of an inch slide in going in, and the same quantity in coming out—so that instead of less than 1-60th of an inch slide, it really has about forty-sixtieths, or above forty times more than the quantity stated.

As to the teeth of a wheel intended to drive others of different sizes—experience shows that if the epicycloid be adapted to the smallest wheel to be driven, a larger will not fail to go well: it is wheels of few teeth that are most difficult to drive; and the epicycloid is unquestionably best adapted to all common purposes, seeing that it acts direct, and consequently produces its effect with the least possible pressure, as I shall explain in a future Number.

JAMES HARRISON.

Barton-upon-Humber,
March 19, 1830.

Remarks by "S. Y." on the preceding Letter.

[Having sent Mr. Harrison's letter and the model which accompanied it to "S. Y." for his consideration, we have been favoured with the following remarks by that gentleman.—ED. M. M.]

Mr. Harrison does not *say*, but the tenor of his whole letter *implies* that I have stated "involute teeth work without friction." Now I defy Mr. Harrison to point out *where* I have said or intimated this. I said that involute teeth worked with little or no friction; that is, of course, with *very little* friction, and that Professor Robison had said, teeth of a certain length on wheels of a certain size, rubbed on each other only $\frac{1}{60}$ of an inch. The first remark, that they worked with "little or no friction," was *mine*, and I am answerable for it; the second was merely *quoted*—I did not *confirm* it, but I said *I saw no reason to doubt its truth*, as the Doctor had no inducement to make the matter appear better than it really was. However, Mr. Harrison *does* doubt it; and I will therefore investigate the matter *myself*, and whatever is the result, your readers shall have a true account of it.

If merely *contradicting* Mr. Harrison is so great an offence, what must he be guilty of who *proves him wrong?* I fear I have sinned past his forgiveness.

Mr. Harrison's model consists of 2 round pieces of wood, about $\frac{1}{4}$ inch

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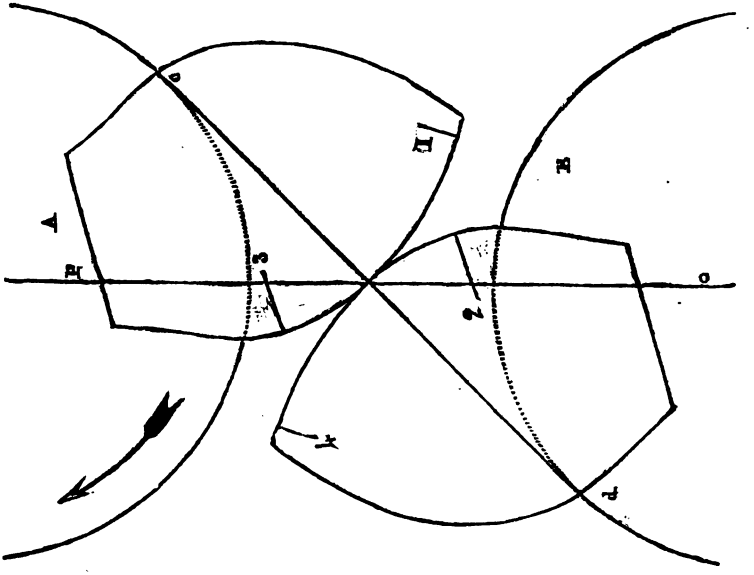
thick and 3 inches diameter (parts of which are shown in the following sketch at AB), which turn on screws, that go through their centres, and are fixed into a piece of flat board.



Upon the round pieces of wood are fixed the teeth, as shown in the drawing. O P is the line of centres. The teeth may be considered to begin their action when the lines 3 4 coincide, and to end it when the lines 1 2 meet each other.

THE RAILWAY SCHEME.

Sir,—On the opening of the Liverpool and Manchester Railway, we shall be favoured with some practical experiments, which will confound many ephemeral writers, whose mathematical and scientific problems have been puffed off, as the productions of men learned and profound.

It has been generally admitted that the reduction of friction is the grand desideratum in railway conveyances; yet, strange and unaccountable as it may appear, our engineers and scientific gentlemen are strong advocates for working the engines solely by friction or adhesion, seemingly unconscious that the friction may, almost, be annihilated, notwithstanding they assert it to be uniform, constant, and regular.

If we apply oil to the surface of the rails, or to that part of the wheel which runs upon the rail, the friction would be so much reduced as nearly to neutralize the power of the locomotive-engine working by adhesion.

The economy of the cog-railway system will be its chief recommendation, and will alone prove sufficiently potent to disturb, if not entirely to remove, the prejudice which has, unfortunately, characterized the management of the Liverpool and Manchester Railway. To say more, might be thought invidious; to say less, as the original projector of the railway scheme, would be doing myself injustice.

Now for a word or two on tunnels; and I shall then wait patiently the event, not doubting that impartial justice will mete out the merit to whom it is justly due.

Wherever railways may be constructed, it will always be most prudent to leave the whole line of country on each side quite open to free

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access, and, consequently, to avoid tunnels as much as possible; for it must be apparent to the most careless observer, that, in every case where a tunnel is or may be made, all direct or immediate communication will be cut off. Whether the proprietors of the land on each side of every tunnel shall patiently and blindly submit to this scientific exclusion from their right of road to the railway, common sense and experience will soon determine.

Nothing but the impossibility of doing without tunnels and inclined planes can be advanced in their support.

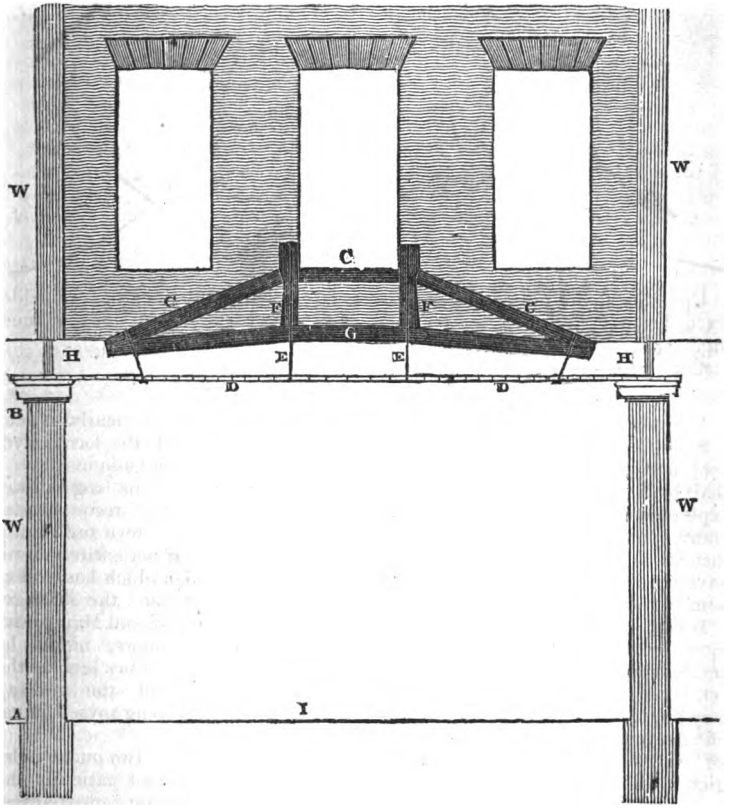
I am, Sir, yours, &c.

THOMAS GRAY,

Author of "Observations on a General Iron Railway."

Nottingham, April 28, 1830.

REMARKS ON SECURING THE FRONTS, &c., OF HOUSES IN CASES OF FIRE. BY MR. C. DAVY, ARCHITECT.



Since my former papers on the subjects of the origin of fires, &c. were inserted in the "Mechanics' Magazine," many calamitous accidents, arising from the conflagration of buildings, have taken place. From this cause, I am again induced to offer a few general observations on this all-engrossing topic.

It is now several years since a so-

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ciety was formed, chiefly consisting of architects, to consider the best means of preventing such dreadful catastrophes. The result of their experiments, conducted (if I recollect rightly) at Wandsworth and in Sloane-street, was of an extremely satisfactory nature. They were published in the form of a pamphlet, one of which I had in my possession, but it is now mislaid. As well as I can remember, the method adopted was to guard those parts of the timbers in buildings most exposed to the action of accidental fires, with what were called plates, similar to what is known by the name of "parquetting." In these experiments the parts intended to have been acted upon were surrounded with all sorts of combustible materials—such as tar-barrels, chopped hay and straw, shavings, &c., and although constantly fed with the same fuel, it either burnt itself out, or lasted for two, three, four, or six hours—slightly charring only the parts in contact, or to go to the extreme, the sides of the joists, quarter partitions, and skirtings. There appears to me good reason for giving credence to the important circumstances elicited by these experiments. A visit to the ruins of the houses lately destroyed in Fetter-lane will clearly show the great non-conducting power of a common lath and plaster party partition, and the propriety of having all divisions of rooms in the *ground-story* of every house constructed of brickwork. The lath and plaster partitions of the adjoining houses that were destroyed, were, no doubt, cooled by a judicious distribution of water from the engines, but if the jets of water were thrown and directed against these partitions, the powerful action of the engines would have been very evident in causing the partial or total destruction of them; as it is, they remain nearly perfect. Most of those wooden buildings erected a few years previous to the fire of London, and which were formerly so abundant in the Strand, Holborn, Fetter-lane, Shoe-lane, and other places, and are now rapidly giving place to brick buildings, were provided with party-walls from the basements to the level of the one pair story, which had an effect in warding off the fire from the plaster partitions above in the adjoining houses. A current of air the width of the party-wall forces its way upwards, and unless a strong wind drives the flames either the one way or the other, they are comparatively safe.

Some of the writers on the subject of fires in the "Mechanics' Magazine," have expressed certain opinions respecting the construction of houses with brestsummer and shop fronts. I perfectly agree with them in many instances. The points of support for houses of this sort are indeed "few and far between," and not nearly sufficient, in the event of a fire taking place. The extreme ends of the brest-summer are but slightly supported in the wall; the extreme and intermediate story-posts therefore burn like matches, leaving about three or four inches for a beam to rest upon, supporting the whole of the superincumbent brick-work, and generally 18 or 20 feet in length. I do not, however, concur with your correspondents that these are ever burnt through; they are only partially burnt and then break. The whole front follows as a necessary consequence. The fact is, that in using iron or wood for brest-summers the material is employed in the worst possible position. It is well known that the heaviest beams, when acted upon by a lateral force, will give way; it is the same with iron. The strongest way of using a beam to support a weight is by compression, and of iron, by tension, downwards or laterally. In the Brunswick Theatre, for instance, a weight hung to the tie-bar of the roof brought the whole to the ground; and in Nicholson's distillery, in St. John's-street, a vat of water crushed the supporting beam in the centre, which was replaced by a suspension truss-girder, on a very excellent principle. Many other circumstances could be mentioned, equally conclusive as to this matter. It is somewhat surprising that the *concealed truss* to brestsummers, shown in the prefixed engraving, should not be more generally employed. In some houses it has been used, but in shop fronts, I am not aware of its introduction: a few improvements upon this plan I shall herewith proceed to

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describe, as it is certain that a judicious combination of wood and iron-work is far preferable to materials of one quality.

In the first place, then, I would have the ground-story of all buildings divided by walls; the flight of stairs, reaching to *the first story* should be of some incombustible material. The ceiling floor over the shop should be arched with coombs, or, as they are otherwise termed, hollow pots. I would then construct the front according to the following directions, which I shall word after the manner of a specification.

Carry up the party-walls of the thicknesses (14 inches) as described in the drawing, and to the heights shown at A, B, at the necessary intervals for the coombed arches. Bed in cement the corbel-stones (of granite or purbeck) for the reception of the girders and brestsummer. The front upwards, to the two pair story, 1½ bricks thick; leave the openings for the necessary windows in reveal, and turn guaged arches over the same with proper lintels, &c. The truss CCC is to have a secure butment upon the ends of the brestsummer H, strapped and bolted through a cradle bar DD, at least 1½ inch thick; fill the spaces between the cradle bar and the lower end of the girder with 2 inch york landing to preserve the lower part of the girder or brestsummer from the action of any fire that may take place. Suspend the cradle bar further by passing the suspension rods EE through the same, by the side of the queen-posts FF, passing through iron-plates in the wall, with nuts and screws upon the top part of the queen-posts; the truss CCC, 6 inches thick, of oak, is to be bedded in the centre of the 14 inch work, and fixed in the centre of the brestsummer, whose scantling is 14 inches wide × 18 inches deep in the middle. The brick-work in the interior and exterior of the building is to be carried up from the line G upon the brestsummer, and the front and back parts of the brest-summer H are to be faced with mathematical tiles to preserve it also from the action of the fire, &c. &c.

This is the principal outline for the construction of the work. The strong posts may be light, for the purpose of forming pilasters, and the corbel-stones may be moulded for the purpose of architectural decoration. A settlement in the fronts of houses is not uncommon, and we find that where a squared beam has been laid upon such stilts as story-posts, they have buckled and destroyed the shop front underneath, for the want of a plan similar to the one now exhibited.

PHYSICAL ESSAYS.

No. 2.

On the Attraction of Cohesion.

Previously to entering upon the main subject of this essay, I shall make a few introductory observations on motion and on attractions in general.

Motion and rest are terms expressive of states, in one or the other of which all matter is found, and are extensively used in ordinary and philosophical language. Hence it is of considerable importance that distinct and definite ideas be attached to these terms. Many writers have consequently attempted definitions of motion (rest being allowed to be its opposite), but their success has not been by any means proportionate to their trouble; for the majority, if not the whole, of their proposed definitions amount to this—motion is motion. Dr. Young in defining motion to be the *change of place*, has given the best definition; but even this is not wholly unobjectionable. The different arguments, *pro* and *con.* may be found in the "Encyclopedia Britannica," Art. *Motion*, where the whole subject is discussed at some length. Some persons have denied the existence of motion: to this opinion we can oppose daily experience, which renders further argument unnecessary.

According to certain writers, motion is either *absolute* or *relative*. This opinion, once very generally received, is now almost as generally rejected; and the prevailing opinion is, that all motion is relative. It appears to me that neither of these opinions is correct, but that motion is both absolute and relative. One motion differs from

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another either in direction or degree: motion is estimated, and indeed its existence is known only by observing the increase or diminution of distance between two or more given bodies, of which some are in a state of motion and others in a state of quiescence, or all in motion, but that motion varying in degree or direction. It therefore follows that motion, as it comes under the cognizance of our senses, is *relative*. But if all creation was to move in one direction to each part with the same velocity, there would be no relative motion, but on the contrary, relative quiescence. As the terms of the case involve no impossibility, the conclusion is unavoidable, that motion is absolute, and may coexist with relative quiescence.

The existence of motion being established, its cause or source becomes the next subject of inquiry. Here let me observe, once for all, that the investigation of *secondary* causes only falls within the province of the physical philosopher. Causation, abstractedly considered, is a metaphysical subject; but when we proceed to apply our abstract reasoning or abstract principles to the explanation of physical phenomena, it becomes difficult to draw a clear line of demarcation between those parts of the subject which are metaphysical and those which are not. The language used by philosophers has tended to increase this difficulty, and has been a fruitful source of error and disputation. Whatever produces motion, or changes the direction of existing motion is called a *force*. All the phenomena of nature prove that the universe is in a state of constant fluctuation, that its parts possess varied and varying motions, and consequently that different *forces* are continually in operation. "The forces which are thus in continual operation, whose existence is demonstrated by their observed effects, but whose nature, seat, and mode of operation are unknown to us, are called by the general name *attractions*."

Whether there is a force of attraction inherent in matter, or whether matter is possessed of *power* or not, we have no means of ascertaining, and therefore our language ought not to involve any hypothetical assumptions. But the contrary is the fact: "The names of the several attractions frequently refer the seat of the cause to specific objects, and seem to imply something respecting its mode of operation. Thus, we say, 'the magnet attracts a piece of iron;' by which expression it is insinuated that the magnet is the seat of the force which gives motion to the iron: that in the production of the phenomenon, the magnet is an *agent* exerting a certain influence, of which the iron is the *subject*. Of all this, however, there is no proof; on the contrary, since the magnet must move towards the iron with just as much force as the iron moves towards the magnet, there is as much reason to place the seat of the force in the iron, and consider it as an agent affecting the magnet. But, in fact, the influence which produces this phenomenon may not be resident in either the one body or the other. It may be imagined to be a property of a medium in which both are placed, or to arise from some third body, the pressure of which is not immediately observed." — *Lardner's Mechanics*.

Why then, it will be asked, is such hypothetical language made use of? In reply we must plead necessity: language, strictly correct, would be so circumlocutory, that a veil of obscurity would be thrown over the whole face of science, and the remedy thus prove, ultimately, worse than the evil. Let the student bear in mind that *effects* and not *causes* are spoken of, and no confusion will arise.

I would not have dwelt so long on the current phraseology, but as I shall make frequent use of it in the course of this essay, I wished to avoid any interruption by subsequent explanations of the terms used.

Material force is either *attractive* or *repulsive*. The attractions are generally divided into two classes. 1. Those which act at sensible or appreciable distances, including gravitation, electricity, and magnetism. 2. Those which act at insensible or inappreciable distances, including cohesion and chemical attraction or affinity.

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As I shall consider these attractions, except that of cohesion, as secondary subjects, and only as far as a knowledge of their laws will throw light upon the main subject of inquiry, I shall omit all consideration of electrical and magnetic attractions.

Gravitation, though generally considered as belonging to the class of attractions, operating at appreciable distances, may be easily shown to be inherent in the constituent particles or atoms of a body. Gravitation when unopposed produces motion, when opposed it produces pressure or weight. Now, since it has been proved that the weight of a body, other circumstances being the same, is proportionate to its bulk, and that the smallest particles in which matter occurs possess magnitude, it follows that atoms possess weight. The distance between these atoms being inappreciable, gravitation and all attractions inherent in them belong to the second class. On this account, the influence of gravitation must be taken into consideration in any investigation of the laws of cohesion.

The law of gravitation is this: "The mutual attraction of two bodies increases in the same proportion as their masses are increased, and as the square of their distance is decreased; and it decreases in proportion as their masses decrease, and as the square of their distance is increased." In this law, the bulk and distance of the bodies are the only objects of consideration; but cases occur in which there is a variation from this law, in consequence of the agency of *figure*. The nutation and the precession of the equinoxes are phenomena which owe their existence to the operation of figure. "These sublime phenomena, produced by the attractions of the sun and moon on the flattened spheroid of the earth, would not have existed had the earth been a sphere; they are connected with its oblateness and rotation, in a manner which may be mathematically deduced and subjected to calculation. But the investigation shows, that this part of the attraction dependent on figure, decreases more rapidly than the principal force. The latter diminishes as the *square* of the distance; the part dependant on figure diminishes as the *cube* of the distance."

In astronomical phenomena, where figure is inconsiderable in comparison with bulk and distance, its effects are subordinate; but in molecular phenomena the very reverse may be expected. This opinion, however, involves the supposition that the atoms are not spherical, of which we have no *direct* proof. A cylindrical atom would not exercise the same attractive force as a spherical atom, *ceteris paribus*; and again, an ellipsoidal atom would attract more strongly in the direction of its smaller than that of its larger axis. But though we cannot ascertain whether the proximate atoms are cylindrical or ellipsoidal, cubical, or hooked-and-eyed, as some ancient philosophers have imagined, we may, I think, be tolerably certain that they are not spherical. I am aware that a contrary opinion is generally held, but its fallacy appears to me to be of easy detection. Fluids evince certain mechanical properties which are possessed by spheres, and this has given rise to the opinion that their particles are spherical. One instance out of the hundreds which might be given, will show that this opinion confutes itself. An aqueous solution possesses the same mechanical powers as water, yet the compound atom composed of water and the salt cannot be spherical, because by the terms of the case, that is the figure of the atoms of water. It is possible that the atoms of the *simple* bodies may be spherical, but all compound atoms must have some other figure. On this account we may expect to find *both* the kinds of gravitation in all molecular attractions. Let us now consider the effects of chemical affinity in modifying cohesive attraction. The leading law of chemical affinity is that the bodies united by its force are united in definite proportions, and when a body is capable of uniting with more than one quantity of another, the second quantity is a multiple of the first. Thus, tartrate of potassa always contains the same proportions of tartaric acid and potassa. These two bodies may, however, be united in different proportions; the *same* quantity of potassa will unite with *double* the quantity of tartaric

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acid, forming supertartrate of potassa (cream of tartar), *but with no intermediate quantity*. Chemical affinity is often called *heterogeneous*, and cohesion *homogeneous* attraction. That cohesion is an homogeneous attraction is true, for it unites particles of lead to particles of lead, of iron to iron, and so on, but that it is not homogeneous *only* is equally true; for to the operation of what other force are we to ascribe the adhesion of gummy, glutinous or resinous bodies to wood, paper, &c., or any other similar heterogeneous adhesions or unions?

There are many cases in which chemical affinity tends directly to the development of cohesive attraction. The union of ammoniacal and muriatic gases is a case of this kind. These gases, as long as they retain the gaseous form, have no mutual cohesion of their constituent particles; but when they are brought into a state of mechanical mixture, they immediately unite, condense, and form a solid compound (muriate of ammonia), possessing a comparatively considerable degree of cohesive force.

The force of chemical affinity varies in different bodies. Although no facts at present known warrant the conclusion that chemical and cohesive attractions are proportionate in their degree, yet there are some cases which have a tendency to establish such a law. Undecomposed bodies possess strong cohesive powers; and on the other hand, in many of those bodies which are easily decomposed, the force of cohesion is but trifling. In several cases, indeed, these attractions are overcome together. For instance, when carbonate of ammonia is decomposed by being put into hot water, the separation of the acid and the alkali, the assumption of the gaseous form by the carbonic acid, and the consequent loss of cohesive attraction, are co-existent phenomena.

Having considered cohesion in connexion with gravitating and chemical attractions, our next inquiry shall be, how is the force of cohesion affected by the distance of the particles in which it inheres; does it follow the inverse law which governs gravitation, or is its law more analogous to that of chemical affinity? Chemical affinity is exercised only within certain limits, and within these, we have no reason to believe that an increase or diminution of distance affects its force. The particles of oxygen and hydrogen are as strongly united in water at the boiling temperature, or in steam of a bulk vastly greater than that of the water from which it was generated, as in water at the temperature of 40° Farenheit, which is its point of greatest condensation. Now experiment shows that the force of cohesion is affected by distance, but does not always obey the same law. In some cases, an increase of bulk is accompanied by an increase of cohesion, and in others by its diminution. Antimony, bismuth, and cast iron, have a less specific gravity when solid than when liquid; ice-water expands considerably in the act of solidifying; yet both the solid metals and the ice possess a greater cohesive force than the liquid metals and water. Lead of the specific gravity of 11·479 having been drawn out into a fine wire, had its specific gravity reduced to 11·317, and on being hammered it became 11·218; yet its tenacity was nearly tripled. This fact was ascertained by Muschenbroeck, and confirmed by Guyton Morveau. The specific gravity of metallic alloys is in some instances greater, in others less than the mean, yet in every case the cohesion is greatly increased. The cases in which cohesion is diminished under the same circumstances are still more numerous. Are we then to suppose that all these contrary phenomena originate in the same cause? Certainly not. As gravitation has its anomalies in consequence of the operation of certain pneumatic laws, as the main law of chemical affinity is not always observable in chemical phenomena in consequence of the interference of mechanical laws; so cohesion is not always an unmodified force. Gravitation and chemical affinity, as shown in detail in the preceding part of this essay, have considerable influence in the phenomena of cohesion.

I have already observed that material force is either *attractive* or *repulsive*. All the phenomena of nature indicate the existence of these opposite forces. Often, indeed generally,

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they exist in the same body; we may therefore justly expect that repulsion will interfere with and modify cohesion. The principal repulsive force is that of heat. The phenomena which arise from the compounded agencies of heat and cohesion are numerous and important.

As this essay has extended beyond its proper limits, I devote the next to the consideration of cohesion as an agent in thermological phenomena.

H. H.

LONDON MECHANICS' INSTITUTION.

Sir,—I was not a little surprised to see an anonymous letter inserted in your Magazine of Saturday last, giving some account of the adjourned meeting, which took place in the Theatre of the London Mechanics' Institution, on the 29th ult. I thought, Mr. Editor, that you were in the practice of obtaining further evidence than an anonymous letter on subjects of importance, before you published such an account as the one in question.

Your correspondent says, "the attendance was even more numerous than on the preceding evening, and the discussion which continued till midnight, equally angry and tempestuous." Now, Sir, it is not the fact to say the discussion was "equally angry and tempestuous," for the meeting was conducted with great decorum, and certainly the feelings of the members did not get the better of their judgments in one single instance. Mr. Clark did not speak at this meeting, he having spoken on the preceding evening, when he read statement "No. 1, the gross receipts, &c." He did not read "No. 2," for that was read on the adjourned meeting only, and that by myself. Your correspondent says, "the committee-party demanded a scrutiny, under the pretence that numbers had voted who were not members." Now as every member who addressed the meeting disclaimed party feeling, it is very illiberal and unjust to throw out the insinuation of "committee-party." It is well known the meeting was called not for the gratification of individuals, but for the settling of that question that had occupied the attention of the members so long. I will next advert to those "as happened to have their member tickets with them." I would ask your correspondent how any but the committee can obtain admission into the theatre without their "member tickets?" Your correspondent says that "Mr. Owen in his attempts to obtain a hearing, experienced a great deal of extremely coarse treatment." An objection was made to Mr. Owen's addressing the meeting, on the ground that he was not a subscribing member, which the chairman very properly overruled, and Mr. Owen then spoke; but when he went into detail of his principles, the chairman called him to order, because he was proceeding in a course irrelevant to the question. If the calling a speaker to order under such a circumstance be "coarse treatment," I sincerely hope any and every person under the same circumstances may be "coarsely treated."

Your correspondent evidently lost sight of the purpose of the meeting, otherwise he would not have written the last paragraph of his letter to which I refer you.

The resolution that was carried, I enclose for your valuable Magazine. The result of the scrutiny was as under,

For the Resolution..... 141
Against it..... 41

Majority....100

The only apology for the length of my letter is, that it is designed to set the truth before your subscribers and the friends of Mechanics' Institutions.*

I remain, yours, &c.
RICHARD CULL.

May 10, 1830.

The Resolution.

"That this meeting being deeply impressed with a sense of the injury the London Mechanics' Institution has sustained by the letting of the rooms of the Institution for political and religious purposes, and being of opinion that the evil will increase if continued, do recommend to the committee to discontinue, without delay, the practice of letting the rooms for such purposes."

Sir,—The warmest enemies of the London Mechanics' Institution could not wish for a more glorious consummation of their desires and predictions than what is now happening,

* The account complained of was headed, "From a Correspondent;" and though the name of that correspondent was not given, it does not follow, as the writer of the letter has inferred, that we were not in possession of it. We know the person who sent it to us well, and had every reason to place the utmost dependence on the accuracy of his information. After all, the utmost that our present correspondent proves against him is, that he mistook the name of one member for another, and thought that to be a noisy discussion, which one of the parties engaged in it (and therefore not the best able to give an impartial opinion on the point) protests was most peaceable.—ED. M. M.

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and I am truly sorry to add my unprejudiced and most reluctant testimony to the truth of what you have written—that the letting of the theatre to such men as demagogue reformists and wild visionaries, has rendered the institution almost contemptible in the eyes of the public. It is now but too true that it is looked upon as the rallying point for republicans and atheists, and the arena wherein any upstart, inspired with the *cacoethes loquendi*, may find a space to exhibit his gladiatorial skill, in denouncing all those who differ from him as enemies to the welfare of the land, instead of its being the favoured spot where the eager inquirer after the truths of science might drink deep of that knowledge, which, instead of revolutionizing and degrading man, inspires him with a due respect for the powers which be. It was a proper motive which induced the conductors of the Mechanics' Institution to let the theatre; they did as all honest men would—they adopted a proper expedient to clear themselves of a heavy debt. How they contracted the debt is not the question, and had much better be let alone;* but it is insufferably odious to hear the cant of the committee about having nothing to do with, and knowing nothing of, the parties who hire the theatre. They *have* to do with them, and they ought to *know* them. It is their duty to take care that no parties have the use of the theatre whose proceedings are likely to cast any odium on the interests they are bound to preserve respectable. The institution is not like a tavern—a public place for public meetings of all sorts. Do the committee suppose that if one of the clubs in the west were to let their rooms they would not make a distinction suitable to the dignity of their society? The committee seeing, besides, how very strongly *public* opinion has set against them, are bound to retrace their steps; and further yet, they are bound to *obey* the voice of their constituents; their laws tie them to the guidance of the general body of members, and I hope that they, the subscribers, will act with firmness and promptitude, for only by so doing, can they wipe away the stigma which now attaches itself to their useful and excellent institution. I have myself ceased for some time, from unavoidable causes, being a member; but the recollection of the benefit and pleasure I received while attending the lectures delivered there, will never cease to make me feel a lively interest in the prosperity of the London Mechanics' Institution.

I am, Sir,
Yours, &c.
T. M. B.

* It is a question of itself, and one which has, I think, according to your own *often* expressed opinion, been sufficiently discussed. I am still of the same mind as in time past, and as ready as ever to defend the propriety of borrowing the money.

New Comet.—Mr. South, the learned President of the Astronomical Society, has directed the attention of the British public to a comet which has recently made its appearance in the Constellation Pegasus. Its right ascension on Tuesday night last, the 11th inst., as determined with Mr. South's five feet equatorial, was at 16 hours sidereal time about 21° 18′, and its northern declination about 20° 56′. It lies between the stars 1 and 2, Pegasi, or as they are marked on Cary's globes, *e* and *f*; these stars are of the 4th and 5th magnitudes, and are distinguishable notwithstanding the moon's light. A line carried through δ and ε Cygni, not quite so far beyond ε as it is from δ, will pass nearly over it. It is increasing its right ascension about 17 seconds of time, and its northern declination about 25 minutes daily. "These directions," Mr. South says, "will enable any one, with common industry, to find it during the moonlight; when there is no moonlight, the comet will probably be visible to the naked eye, perhaps without a tail, and not unlike the great nebula in Andromeda." Mr. South very candidly adds, that he is indebted for a knowledge of the existence of this comet to "the friendship of the indefatigable Gambart, Director of the Royal Observatory at Marseilles," where it was seen on the 21st of April last.

Exportation of Machinery.—It appears from a return recently made in Parliament, that the value of the machinery exported from this country, for the last six years, has been as follows:—

1824	£129,652
1825	212,416
1826	233,955
1827	214,129
1828	265,368
1829	256,539

In 1824 the value exported in "steam-engines and parts of steam-engines," was £28,123. In 1829 this item had increased to £133,573, forming more than one half of the whole machinery exported.

INTERIM NOTICES.

We have received, on the Gilman Controversy, letters from A Practical Engineer—Peter Pindar—Mr. Butler—Another Looker-on—and Mr. William Smith (the last with a promise of a continuation)! Will this controversy never have an end? We shall endeavour next week to exhibit, in a small compass, the substance of the letters before us, but cannot promise to give any more letters on the subject at length.

Communications received from B. H. L.—Nauticus—Mr. Merrick—Mr. Baddeley—I. B, J.—Tempora—P. J. D——g.—Mr. E. Sweet—Another Looker-on (*secundus*)—C. D. S.

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M. SALMON, Printer, Fleet Street.

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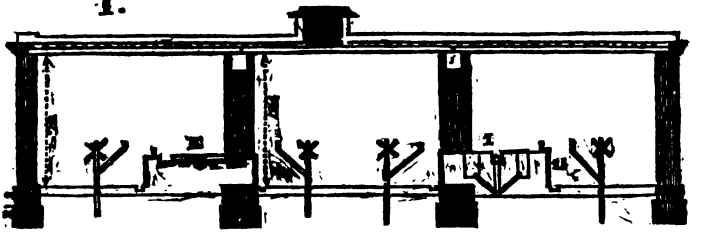
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 354.] SATURDAY, MAY 22, 1830. [Price 3d.

STEAM FILATURE FOR UNWINDING SILK COCOONS.

1.



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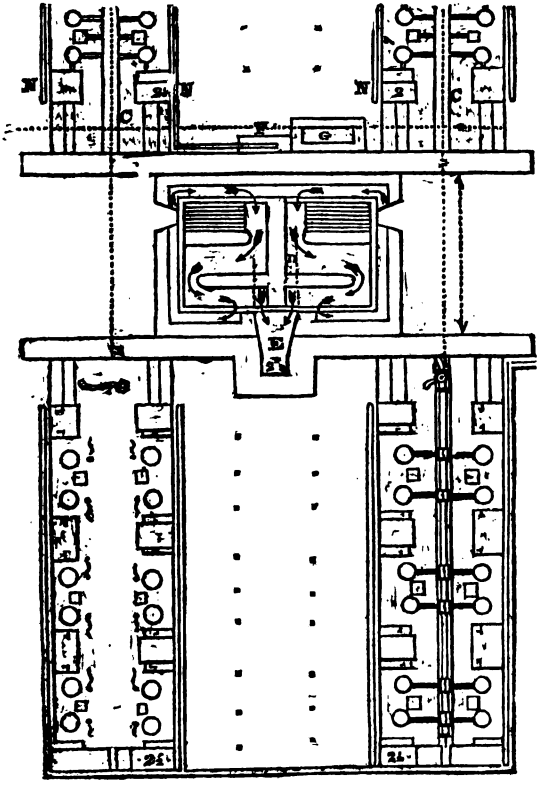

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DESCRIPTION OF A STEAM FILATURE FOR UNWINDING SILK COCOONS, ERECTED AT COMMERCOLLY, IN BENGAL, BY R. RICHARDSON, ESQ., RESIDENT AT COMMERCOLLY; FROM DESIGNS BY CAPTAIN J. SOMERVILLE, EXECUTIVE OFFICER OF THE DEPARTMENT OF PUBLIC WORKS.

Silk, as most of our readers are doubtless aware, is furnished by the insect to which we are indebted for this valuable commodity, in the shape of small cocoons or balls of natural thread; and the first thing to be done, in order to adapt it to the manufacture of fabrics for human use, is to unwind these cocoons. The thread in this state is so fine, that more than 10,000 yards have been wound off a single cocoon in one unbroken length. The average length, however, produced by cocoons is only about 750 yards, and sometimes they do not yield more than 250. As silk-thread of any of the degrees of fineness in which it comes from the worm is unfit for manufacturing purposes, the ends of several cocoons are brought together, and the whole reeled off by an operation, which at once unwinds them and twists them together into one strong and smooth thread. Before the cocoons can be thus unwound, they have to be steeped for a short time in hot water, in order that they may be freed (with the help of a scrubber, usually made of rice-straw), from the loose threads in which they are enveloped in their rough state, and that the gum with which they are naturally impregnated may be sufficiently softened to admit of the thread coming off easily. They must remain, too, in the hot water while the process of unwinding is going on, it being necessary that they should be kept throughout the operation in the same soft and unadhesive state. A bar, perforated with holes, is accordingly fixed across the top of the hot-water basin; the threads are drawn through one or other of these holes, and transferred by means of a rail or layer, as it is called, to the reel, and twisting-machinery connected with it. Besides the hot-water basin, it is requisite to have another at hand containing cold water, in order that the person who superintends the operation may cool his fingers occasionally, as well as reduce the temperature of the cross-bar, by sprinkling cold water upon it when it happens to get too hot. It is very necessary, to obtain a good silk-thread, that all extremes of temperature should be avoided; when there is too much heat, the thread has no body, and is of a dull appearance; when there is too little, the ends do not join well, and the thread is harsh and uneven. The better to ensure this equality of temperature, it has been usual to use charcoal-fires for heating the basins; charcoal having the farther advantage of being free from smoke, which would be injurious to the colour of the silk.

We have given this general explanation of the mode of unwinding cocoons hitherto in common use, that our readers may be the better enabled to understand and appreciate the merit of the improved plans which we have now the pleasure of bringing under the notice of the European public. They are the production of Robert Richardson, Esq., the British Resident at Commercolly, in Bengal, (by whom they have been kindly transmitted to England for our inspection), and Captain Somerville, of the 16th Regiment; and add another to the many honourable proofs already existing of the advantages conferred on the manufacturing processes of India by British skill and intelligence.

The plans transmitted to us include complete working-drawings of all the parts of a filature (as factories of this kind are termed), erected at Commercolly under Mr. Richardson's direction, and in which steam is made use of instead of the direct agency of fire for heating the basins in which the cocoons are prepared for winding. We give only as much of these plans as may serve to explain the mode of construction adopted at Comercolly; but should any person be desirous of erecting a steam-filature on a similar plan, and be desirous of farther information, we shall willingly favour him with copies of the whole.

Descrivtion of the Engravings.

A. Ground-plan, fig. 1) shows the hot and old-water basins, and appa-

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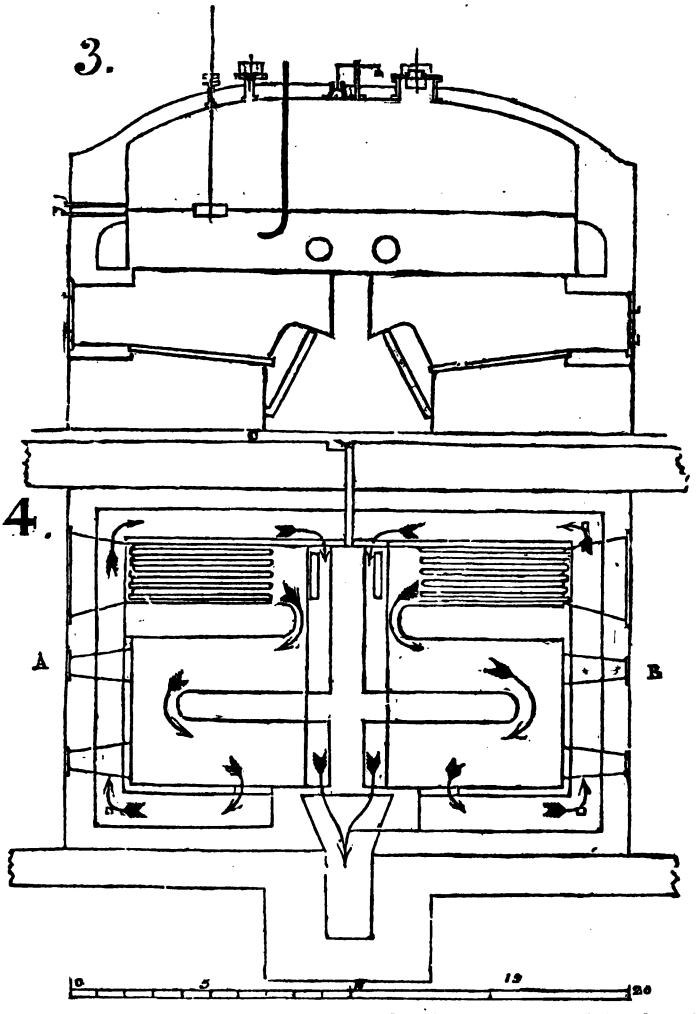

ratus for supplying the steam in its finished state.

B. The steam-apparatus, with the steam main and branch-pipes uncovered.

C. The masonry as it is finished and ready for introducing the cold water, and steam-apparatus.

Note.—That only two or three pairs of basins are shown in these instances. Each boiler is stated to be calculated to work 100 basins.

D. The seat of the boiler, direction of the flues, &c. The furnace-door is made of plate-iron, and lined with fire-clay.

E. The chimney, which is raised to 40 feet above the bottom of the boiler.

F. A pipe and waste-cock from the boiler for cleansing it out when necessary.

The dotted lines show the direction in which the main and branch-pipes of the cold-water apparatus are laid down under the tiles of the floor and apparatus-masonry.

G. A cistern, which is kept con-

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stantly filled with cold water by a branch-pipe from the cold-water apparatus, and from which water is pumped up by means of a self-acting apparatus into the larger cistern H, which supplies the boiler with water.

I, (fig. 2) is a section of the apparatus-masonry, showing the steam-apparatus only. And,

K, a section, showing the cold-water apparatus only.

NN, are the foul-water drains.

Fig. 3, is a section of the boiler through the line AB of the plan fig. 4.

Fig. 5 is a section, and fig. 6 a plan of a steam-basin.

Fig. 5. Fig. 6.

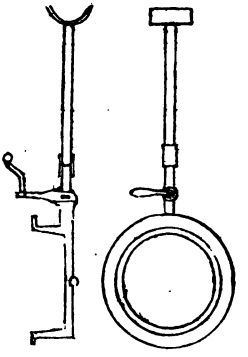


Fig. 7. A ball-valve for regulating the supply of water from the cistern G, and fig. 8 a section thereof.

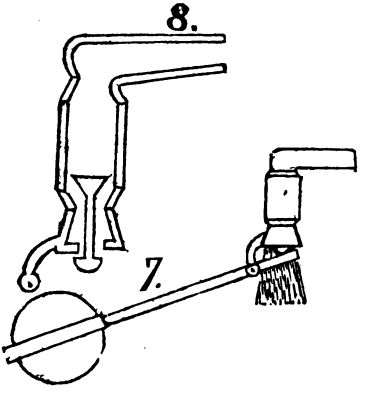


Fig. 9 is a plan of the cold-water reservoir, and fig. 10 a section of the same through the line AB.

Fig. 9.

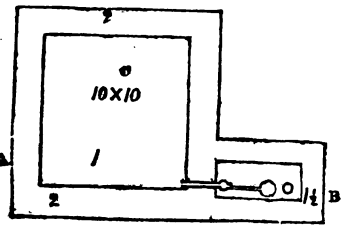
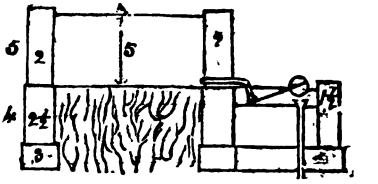


Fig. 10.



For a farther explanation of these different figures, and their uses, we beg to refer our readers to the following letter from Mr. Zornlin, a gentleman of London, to whom Mr. Richardson's plans have been also submitted, and who, we understand, is well qualified, by his practical knowledge of the silk manufacture, to judge of their worth. In our own humble opinion, the arrangements of this steam filature are altogether extremely well contrived and judicious. Mr. Zornlin speaks of "a little alteration," by which fuel might be saved, and of a "trifling addition which would render the apparatus available to another operation intimately connected with the winding off the raw silk." We shall be glad to receive from Mr. Zornlin, for publication in our pages, a more particular specification of the "alteration" and "addition" to which he here alludes, in order that a knowledge of the improvements of which the apparatus is susceptible may be as extensively circulated as this account of the apparatus itself. To our numerous readers in the United States,* where the growth of silk has become of late a favourite ob-

* An American edition of the "Mechanics' Magazine" is regularly published at Boston by Messrs. Gray and Bowen; and we are happy to learn, that the work is nearly as great a favourite in the United States as it is at home.

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ject of industry, and where the climate, in many parts, is extremely favourable to it, the information which Mr. Zornlin is invited to furnish, is likely to be particularly acceptable.

" Dear Sir,—I beg to offer the following remarks as my explanation of the drawings sent by Mr. Richardson, comprising plans, elevations, and sections taken from a steam-filature for raw silk, erected by that gentleman at Comercolly.

" In the drawings, D, E, F, G, H, are the boiler, flues, chimney, cistern, and pipes for supplying the boiler, furnace-door and ash-pit; they require no particular notice, as being merely a modification of some of the various approved means for producing steam.

" Connected with the boiler, and supported by masonry about 15 inches above the level of the floor, there are horizontal steam-pipes ranged parallel to the length of the building: from these main-pipes small ones branch off on each side and lead into cylindrical cases enclosing open pans; the steam, which may be admitted into the spaces between the pans and their cases, is carried off either condensed or as vapour by pipes leading from the bottoms of the cases to the foul-water drains. There are cocks to the main-pipes, to the branch-service pipes, and to the eduction-pipes—by a proper use of which cocks, water in the pans may be raised to and maintained at any temperature that can be required for the purpose.

" At about the level of the floor, underneath and parallel to the main steam-pipes, water-pipes are laid in the masonry; branch-pipes inclining upwards, lead from these into small cisterns constructed in the masonry contiguous to the pans and level with them—a cistern to every pair of pans. There is also a branch-pipe leading to the cistern G for the service of the boiler. The main-pipes must, of course, have a constant supply so regulated as to keep the water at a proper height in the cisterns. There is, however, nothing in the drawings relative to this purpose except in figs. 7 and 8, where a reservoir and regulating ball-valve are sketched. The pans are conical, about 15 inches diameter at the top and 13 inches at the bottom, which is flat—their depth is 4½ inches, according to the scale. At top they have flange-rims corresponding with others at the tops of their cases, by which they are joined together. The cases are set in masonry, their rims being about two feet higher than the level of the floor.

" To use the apparatus, the steam in the boiler being well up and turned on into the main-pipes, water must be baled from the small cisterns into the pans, and the steam let into the pan-cases: when the water in any pan is sufficiently hot, a certain number, perhaps 25 or 30, of cocoons that are in a fit state for winding off are to be thrown in, and the silk may be wound off on reels in the usual way. The pans being kept supplied with fresh cocoons, the work proceeds regularly. An even temperature and the absence of smoke are almost indispensable; steam, therefore, seems suitably applied, and is, undoubtedly, a great improvement on the method practised in Italy. I have no doubt it is also much superior to the usual way of working in India.

" Granting, as I do, every commendation to Mr. Richardson for the application of steam-baths to a fresh purpose—I must take leave to say, that in my opinion, by a little alteration in the arrangement, some fuel would be saved; and that a trifling addition would render the apparatus available to another operation intimately connected with the winding off the raw silk.

" I am, dear Sir,
" Yours truly,
" J. J. ZORNLIN, Jun."

23, Threadneedle-street,
May 1, 1830.

" P. S.—Should the East India Company desire the construction of any more steam-filatures, there can be no doubt, as Mr. Richardson suggests, that great part of the apparatus could be made cheaper in England. It would not be very expensive, and the drawings are quite sufficient to execute the work from."—*J. J. Z.*

SQUARING THE CIRCLE.

Sir,—My books on mathematical subjects being but few, and never having seen any attempt to establish some general principles for the division of right lines, I was induced to send you the query contained in your Magazine for December 20, 1828, p. 336; being of opinion, that if some really scientific method were found out, it would help to find a right line, which should be a tolerably correct representation of the side of a square equal in area to any

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given circle; and although the query did not produce the general rule which I expected, I was obliged by the communication contained in your Number of March 11, 1829. I have a few propositions relating to this subject which I will take an early opportunity to arrange and forward to you.

I am induced to trouble you now by an article contained in your Number of April 24, p. 116, wherein it is stated that Major-General Ouseley has discovered several *new* approximate methods for finding the area of a circle. The rule there given is not new to me, and I beg to state that I met with it (amongst many others) a long time ago, but seeing that it was easily derived from the long-known fraction $\frac{355}{113}$, (which produces, I believe, the nearest approximation to the circumference of a circle having unity for its diameter of any yet found, involving so few figures in the numerator and denominator,) I did not think it of sufficient importance for the pages of your Magazine. The process which I followed was this. I separated the integer from 3·14159265 $=\frac{355}{113}$, and sought for the reciprocal of ·141592, &c. The process, compressed as much as possible, was $\frac{1}{\cdot 14159265}\times 16=113$, and $113\times 3+16=355$, therefore $\frac{355}{3}=3+\frac{16}{113}$: now, as it is well known that one-fourth of the circumference of a circle whose diameter is unity is equal to the area of such circle, the rule which is said to be *new* appears to me to be only the old fraction $\frac{355}{113}=3+\frac{16}{113}$, expressed in other terms; for if $3+\frac{16}{113}$ be divided by 4, the result is $\frac{3}{4}+\frac{4}{113}$, which is only equal to $\frac{355}{113}-4=\frac{355}{452}$.

This does not seem a single step forward: what we want is a right line; we want no more approximations in figures.

As to the latter part of the General's communication, I must leave that for more competent judges; and shall only observe, that I have a method which I think will enable any one to draw a square equal to any given circle, with as much ease and accuracy as a square or an equilateral triangle can be constructed on a given line; which I intend to submit to the public soon.

I remain, Sir,
Your constant reader,
M. W.

P. S.—Whether the process by which I produce the fraction $\frac{355}{113}$ will be something new to your readers, I cannot tell; my own reading, which is very limited, had never met with it. As many similar approximations may be obtained as can be desired, by only varying the quantity of which you obtain the reciprocal: thus, assume 3·5, subtract 3·141592 } the remainder, ·3584, is now the quantity to produce the reciprocal; and the result will be $\frac{7}{2}-\frac{100}{279}$, for an approximate value, which is true to the fourth place of decimals inclusive.

INSTANTANEOUS CONVEYANCE OF INTELLIGENCE.

Sir,—Seeing your notice of M. Amperes' curious telegraph, last Saturday, I beg to hand you a prospectus which I have had by me some months, of a book which is to contain an account of a mode of instantaneously conveying intelligence to any distance, discovered by a Mr. T. W. C. Edwards, M. A., on a principle which he describes as "altogether different from every kind of telegraph or semaphor." I understand the book is not yet forthcoming for want of subscribers to pay for paper and print (though the number required is only 200 at a guinea each): this, I think, is a pity; for if there be no deception practised, there can be no question, I presume, about the importance of Mr. Edwards' discovery.

I am, Sir,
Your obedient servant,
Wm. Sims.

Shoreditch,
April 21, 1830.

The paper obligingly handed to us by our correspondent, is entitled, "Prospectus of a new and curious Work, entitled a Developement of the Principle and Structure of the Auticatelephor; an Engine for the Instantaneous Conveyance of Intelli-

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gence to any Distance. — By the inventor, T. W. C. Edwards, M. A., Lecturer on Experimental Philosophy and Chemistry."

The Prospectus itself is not long, and is sufficiently curious to merit insertion.

"When it is considered," says Mr. Edwards, "that sound travels only 1142 feet in a second, or about 13 miles in a minute; and that the greatest velocity of a cannon-ball has never exceeded 4000 feet per second; and that light, the fleetest of all things known, requires nearly seven minutes and a half to speed its way from the Sun to the Earth: few persons will believe it possible for man to have discovered a means of holding, at the distance of hundreds or even thousands of miles, and across the sea, converse with a friend, in the most perfect manner, and on any subject whatever, *instantaneously*, either by day or night.

"But, before the discovery of the properties of the loadstone, who could have believed that a needle should one day be the seaman's unerring guide, in all sorts of weather, and even the darkest night, to regions the most remote; and over seas that scarcely own a shore? Or who, before the invention of gunpowder, would have ever believed it possible for man to throw a 64lb. shot, or a shell weighing 2 cwt., to the distance of a mile and upwards in a few seconds? Or who, before the expansive force of steam was proved, could have believed that the vapour of water should ever give a rapid and continued motion to machinery which the combined strength of more than 100 horses could not stir? Or who, even half a century ago, would have deemed it possible for a human being to have ascended 10,000 feet into the air, and after soaring for an hour above the clouds, to have alighted, in perfect safety, 50 miles from the place of his ascent? Yet all these things have been done, and we no longer wonder at the effect. The public ought not, therefore, to look with too much severity upon a project, though apparently impracticable; but should rather encourage a spirit of laudable research.

"The inventor of the Auticatelephor undertakes to demonstrate clearly and briefly in the work which he has now in the press, the practicability and facility of transmitting from London, *instantaneously*, to an agent at Edinburgh, Dublin, Paris, Vienna, St. Petersburg, Constantinople, the Cape of Good Hope, Madras, Calcutta, &c., any question or message whatever; and of receiving back again at London, within the short space of one minute, an acknowledgment of the arrival of such question or message at the place intended; and a distinct answer to it in a few minutes.

"In principle this engine is altogether different from every kind of telegraph or semaphor, and requires neither intermediate station nor repetition. In its action it is totally unconnected with electricity, magnetism, galvanism, or any other subtle species of matter; and although the communication from place to place is instantaneous, and capable of ringing a bell, firing a gun, or hoisting a flag, if required, yet this is not effected by the transit of any thing whatever *to* or *fro**—nor in the operation, is aught either audible or visible except to the persons communicating. It may be proper, however, to state, that a channel or way must previously be prepared, by sinking a series of rods of a peculiar description in the ground, or dropping them in the sea; but these, after the first cost, will remain good for ages to come, if substantial when laid down.

"It is right to apprise the public, that the inventor has explained (in confidence) the secret of his invention to several very scientific men, and as competent as any to judge of its merits: among others, the Vice-President of the Royal Society; the Professor of Natural Philosophy and Astronomy in the University of London; and the President of the Mechanics' Institution. He had previously made an offer on the subject to his Majesty's government, but without acceptance. His wish is, therefore, to place on record the era of the first application of a well-known principle, to a new and truly curious purpose, in a full developement of the means and method of communicating *instantaneously* with a friend at any distance whatever, from a few yards to ten thousand miles or upwards.

"On a small scale, the Auticatelephor cannot fail to be a source of rational recreation and amusement to noblemen or gentlemen, living at short distances from one another, and disposed to converse together through the medium of a truly elegant and novel invention."

We agree with our correspondent, Mr. Sims, that it is a pity so notable a discovery should remain a secret for want of adequate patronage, and hope

* Not even of motion?—Ed. M. M.

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this notice may have some effect in increasing the list of subscribers. Mr. Edwards address is "Homerton, Middlesex."

TIN LACKER.

Sir,—Your correspondent F. L. M., No. 316, inquires for a lacker for tin; perhaps the following may be useful.

Take 8 ounces of amber, 2 ounces of gum lac, melt them in separate vessels, and mix them well together; then add half a pound of drying linseed oil. Into a pint phial put half a pint of spirits of turpentine, and digest in it a little saffron; when the colour is extracted, strain the liquor, and add gum tragacanth and anotto, finely powdered, and in small quantities at a time, till the required tone of colour is produced; then mix this colouring matter with the first compound before prescribed, and shake them well together till a perfect union takes place. If this varnish be laid over silver-leaf or tin-foil, it will be difficult to distinguish it by the eye from gold. It is by a varnish of this kind that leather, paper, or wood, covered with silver-leaf, is made to appear as if it were gilded. The lacker is also applicable to tin-plate articles, but small articles of finely polished brass are usually coated with a thinner composition. Wishing that it may answer your correspondent's purpose,

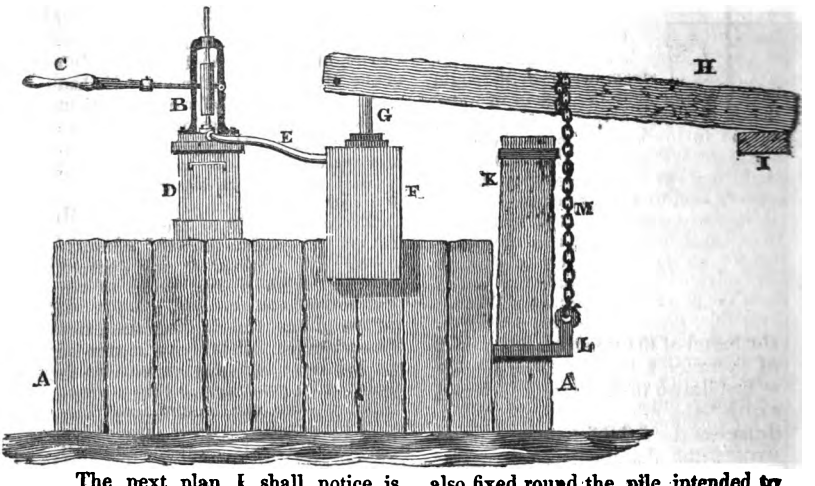
I am, Sir,
Yours, &c.
B. S.

DESCRIPTIVE ACCOUNT OF THE PRINCIPAL BRIDGES ERECTED OVER THE RIVER THAMES. BY MR. C. DAVY, ARCHITECT.

No. XIII.

Machinery for Withdrawing Piling—Weighing-machine described—Bramah's Pump—Mr. R. Christie's Improvement upon the Pulley.

Fig. 3.



The next plan I shall notice is known by the name of the "weighing-machine," for drawing piles out of the water. It simply consists of a flat-bottomed craft or barge, having at one end a windlass, and at the other a strong chain, which is also fixed round the pile intended to be raised. In the centre of the barge, and laid longitudinally, are two stout planks or beams, forming a rail-road for a truck, loaded to the amount of several tons weight; which truck is made fast to the chain coiled round

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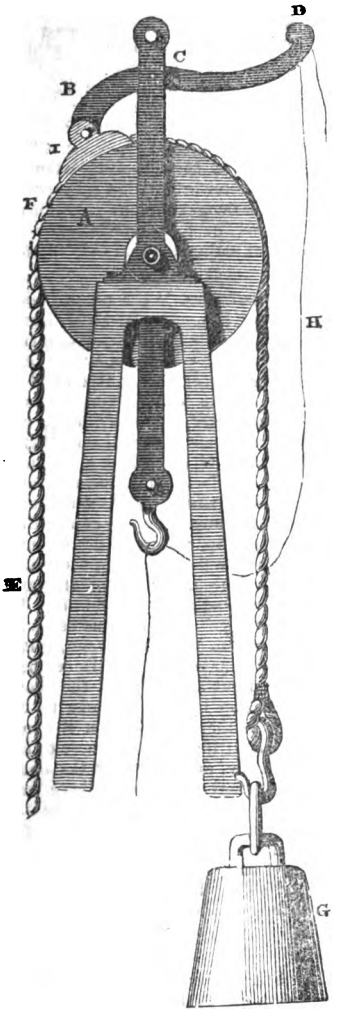
Fig. 4.



the barrel of the windlass. The mode of operation is as follows. The truck is first drawn to that end of the barge nearest the pile, which considerably depresses the end of the barge in the water; the chain is then fixed round the pile—the windlass is now, in its turn, put into operation, drawing the truck towards the opposite extremity of the barge; the consequence is, that this end becomes depressed and raises the pile at the other end.

At Waterloo Bridge Bramah's pump was used for the purpose of withdrawing the piling. Fig. 3 shows the arrangement employed; AA shows part of the piling of the coffer-dam; B is the pump fixed upon the top of the piling; by working the lever or handle C, water is withdrawn from the cistern D, and forced through the copper pipe E into an iron cylinder, enclosed within a block of wood F, firmly fixed to the piles; the solid plunger G is by this force protruded, and raises a beam H, placed upon another beam I, as a fulcrum; a loose ring of iron L is dropped round the pile K, and the chain M passes several times round the beam H. Now the loose ring L, by being drawn upwards by the chain, will shift itself into an angular position, and will take an immense purchase upon the pile, causing it to follow with the elevation of the beam H till it is completely withdrawn from its situation.

All the preceding methods are very effective, and the choice of them will depend entirely upon the taste of the engineer. That of the barge is the most simple; and the mechanism for its construction has this advantage, that it is always at hand.

Pulleys and blocks are so essential in the lifting of heavy weights—and the former have been so often mentioned in these papers, that I shall take this opportunity of introducing to the notice of the readers of the "Mechanics' Magazine" a highly meritorious addition to the common pulley, invented by a gentleman well known in the scientific world—Mr. R. Christie, of the London Mechanics' Institution. The object of it is to put an end to the many deplorable accidents that are constantly happening in buildings and in factories, from heavy weights suddenly falling, owing to the want of some contrivance for suspending them at any distance from the ground, and the successful manner in which Mr. Christie has accomplished this desirable end entitle him to the gratitude of mechanics in general. It is true that where the wheel and pinion are employed we have ratchets; but still the common pulley is often brought into requisition for the raising of weights nearly equal in bulk, in which case the ratchet is

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not only cumbersome but expensive. The merit of this gentleman is the greater, that instead of permanently securing to himself the pecuniary advantages arising from so useful and original an invention, he introduced it at once to the public in a late lecture delivered by him on the advantages of friction, when the contrivance seemed duly appreciated by the audience. Hundreds of pounds have been expended in taking out patents for things that do not combine one-tenth part of the usefulness which this simple contrivance exhibits. Fig. 4 is a sketch of the pulley fitted with Mr. Christie's apparatus; A, the pulley; BCD a lever, which rests upon the cord EF, and prevents the descent of the weight G. The string H is used to disengage the lever from the pulley, and the rope AE to lower the weight. The piece at I is of metal, jointed on to the lever; this piece is hollowed on its underside to embrace the rope more firmly. If the pulley is in a vertical position, as shown in the drawing, the weight of the jointed piece I is sufficient to keep it fixed to the rope; but if the pulley swings to and fro, a small spring is necessary. It is almost needless to mention, that the greater the weight the more firm will the lever hold the cord. Mr. Christie is now employed in making farther improvements upon this contrivance, which may also be advantageously employed in the raising or lowering of materials in buildings, or taking down houses.

Where piles are not withdrawn from the river, the ends are sawn off, as at Westminster and Blackfriars Bridges, by curious machinery—to be hereafter described in treating of those structures.

(To be continued.)

REMARKS ON MR. GILMAN'S CASE.

(Abridged from the various letters received on the subject.)

By a Practical Engineer.

Some time ago Mr. Gilman insinuated that Messrs. Braithwaite and Ericsson were sore about his pretended inventions, as set forth in his celebrated narrative. He now talks of "the soreness which the friends of Mr. Hall have displayed;" in short, he does every thing but "*grapple at once with the facts of the case*" (as he was recommended to do in the outset by the Editor). Pray what has the soreness of any of those gentlemen or their friends to do with the matter in dispute? Even Mr. Gilman's apologist, S. Y., finds it necessary to ask Mr. Gilman "whether he had not better prove what A Practical Engineer challenges him to prove, page 117, No. 351, or give satisfactory reasons for not doing so, and *thus end the dispute.*"

Mr. Gilman says, "the plans which I proposed (viz. to Messrs. Pearson and Witty) were those of the two last modifications; namely, first to excite the fire by means of a blast, and to cause the flue to terminate in a cistern or vessel of water, in order to the retention of the carbonaceous and other ponderable matter, by which a chimney would be rendered unnecessary, and that nuisance, smoke, got rid of; and second, to procure a draft by connecting an exhausting apparatus to the cistern, or vessel, above the surface of the water in which a flue might terminate, and thus the necessity for a chimney be also done away." Now let us see how this squares with Messrs. Pearson, Witty and Gilman's patent of 13th December, 1826, taken out a year after the above communication by Mr. Gilman to his partners. Is there a word in it about creating an artificial atmosphere of superior density, and effecting the combustion of fuel in it? Is there any thing in it at all touching upon the objects mentioned in Mr. Gilman's narrative, as contained in your numbers for December 5 and 12, 1829? No, not a syllable! the patent is merely for one of those modes of applying fire to a boiler, of which so many have been devised.

Mr. Gilman says farther, near the conclusion of his letter, "I should be glad to be informed as to whoever proposed to produce an artificial atmosphere by exhaustion, or indeed whoever proposed to work an engine by a mixture of atmospheric air, or rather the nitrogen of the atmosphere and steam from either of the two last modifications. For a certainty I never did, nor could any person understand either my narrative or explanation to imply any such absurdity." If Mr. Gilman will refer to No. 330 of the Mechanics' Magazine, page 260, he will there find the information which he says he shall be

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"glad" of. The person who furnishes it is no other than the said Mr. Wm. Gilman himself—"The last *modification* which I shall now notice is the application of an exhausting apparatus *over the surface* of the water *in which the flue terminates*, instead of forcing the air into the fire; by this means a partial vacuum is formed *above the surface of the water* equal to any required draught," &c. "For a certainty," Mr. Gilman, it was you, and you alone, who was guilty of the "absurdity." You describe your exhausting apparatus as being *over the surface of the water:*" and you say the flue *terminates in* the water. What then could act upon the piston but this mixture of steam, nitrogen, &c.? And what is this but producing "an artificial atmosphere by exhaustion," &c.?

S. Y. says, his question to me was not how Mr. Gilman's joints might be made *without turning*, but how the faces were to be brought near together *without being turned*. Perhaps he will kindly inform us what is the logical difference between *without turning* and *without being turned*. The former, however, was his own phrase (see Mechanics' Magazine, No. 348, page 89).

Reasoning *a priori*, the illustration of the safety-valve would appear quite conclusive against me with respect to the weight necessary to secure high-pressure steam; but I repeat that a vessel, two feet in diameter, with joints, such as Mr. Gilman points out in Mechanics' Magazine, No. 330, will not retain steam with *double* (as S. Y. says), or even treble the weight of its aggregate pressure, if such weight be placed at the edges of the cover; whether its great dimensions cause it to spring (for I speak of a pressure of upwards of 200lbs. on the square inch), I cannot tell; but as I speak from practice, I am not to be baffled by a theoretical or speculative opinion. How far a less weight would answer if equally distributed over the whole surface of the cover, instead of being placed at the edges, I am not prepared to say, but I am inclined to think a much less pressure would do.

S. Y. seems to think he has put *an end* to the question about the bolts which has made so much noise, by saying "what I said of them was, that their strength and fitness should be estimated by *their area as given by Mr. Gilman*, and not from a drawing which in all probability was not intended to give their sizes." Now I shall be obliged to Mr. S. Y. to inform me *where* I can find *their area as given by Mr. Gilman*, except in his drawing, as I cannot discover it in any of that gentleman's writings.

By Mr. Wm. Smith (of Leicester.)

[This communication, from its more pointed character than any of the others before us, we give with comparatively little abridgment. We request Mr. Gilman's particular attention to the first passage marked in italics.—ED.]

At the request of a few friends at this place who take in the Mechanics' Magazine, and who have found the Gilman controversy to be a subject of more than ordinary interest, I write to ask Mr. Gilman a few plain questions, and hope he will for our government, in judging between him and his opponents, favour us with equally plain answers.

I have adopted the mode of asking simple questions to draw and confine the attention of all parties to the real points in dispute, and to prevent their flying off in a tangent as it were, to mere desultory and irrelevant matters. I shall strictly confine my questions to those points of the controversy which have been agitated, but not in the least settled.

Mr. Gilman may depend upon it the more plainly and the less equivocally he answers our questions, the more will he "grapple with the facts of the case," and satisfy the public.

Question 1st.—As Mr. Gilman says, "in 1826 my attention was directed to the most economical method of generating steam," &c.; and as he states that, "*in that year* the apparatus exhibited by the accompanying drawings, (*i. e.* in your 330th number) was executed, and is now in existence," will he have the goodness to inform us why he never mentioned this invention in the slightest manner, before the 5th December, 1829, although he has been taking out patents for generating steam and the application of heat, and successively publishing his discoveries and inventions in the Mechanics' Magazine, from as early a period as 19th October, 1824, (see Mechanics' Magazine, vol. 3, page 94,) up to the above-mentioned time?

Question 2nd.—In operating with his generator, did Mr. Gilman find that the blast (as in the case of "The Novelty") destroyed or injured the apparatus, particularly the fire bars, the pipes F, fig. 2, branching from the fire chamber, and pipe F, fig. 1, branching from the top of the generator?

Question 3rd.—As Mr. Gilman ex-

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plains that the fire chamber, although it is stated in his narrative, and shown in his drawing to be *full* of *ignited* fuel, was in fact filled with *un*ignited fuel for store, except a small quantity in combustion at the bottom, we shall be obliged by his informing us whether in his actual operations the tar was distilled from the store fuel (as A Practical Engineer intimates would be the case), and whether such tar mixed with dust and ashes had any injurious effect in choaking the small pipes E, and the valves placed at their ends, and whether any water stole its way through those valves and pipes into the fire chamber?

Question 4th.—As it is intimated that the thickness of the bolts of Mr. Gilman's generator was not intended to be shown by the drawings (by which they appear to be only three quarters of an inch square), will Mr. Gilman favour us by saying what size they *really* were, that we may know what thickness is sufficient to confine steam of 300lbs. upon the square inch, in a vessel two feet in diameter, when only twelve bolts are used?

Question 5th.—By Mr. Gilman's drawing, fig. 2, of his generator, the small joint at the top of the fire-chamber appears to be made by grooves and a copper wire, but the other three large joints, viz. that at the bottom of the fire-chamber, and those at the top and bottom of the outer cylinder, are shown as formed by plain surfaces; but as Mr. Gilman explains that they too were made by grooves and copper wires, he will perhaps inform us why those joints were not also shown in the drawing, seeing it was taken from an apparatus actually used and in existence?

Question 6th.—As much has been said about the making of these joints, we should be much obliged by Mr. Gilman's explicitly informing us why he says the ends of the cylinders were *accurately* turned and *nicely* faced TO JOINT WITH THE CYLINDERS, if he made the joints with grooves and copper wires, by which plan those accurately and nicely-faced surfaces would be kept asunder, and therefore could not so *joint with the cylinders*?

I much wish Mr. Gilman would at once give such answers to these two last questions as to set the matters at rest; for notwithstanding all that has been said upon them, some of my friends pertinaciously insist that the inconsistencies in the drawings and the words "*to joint with the cylinders*," show that this account of the joints is altogether theoretical and not practical, and if that be but once established, they contend that it follows of course that the whole of Mr. Gilman's apparatus and narrative is of the former character.

By Peter Pindar.

"S. Y." sneers at my last communication, being headed "Opinions in Manchester on the Gilman Controversy;" I can assure you, Sir, that the opinions in question are not confined to one individual, but very general indeed, in this place; and that though those who entertain them might *possibly* prove of "no very great consequence," when compared with so distinguished a luminary as "S. Y." they nevertheless shine with considerable brilliancy out of the sphere of his dazzling rays.

"S. Y." in allusion to what "A Practical Engineer" says about Mr. Gilman's joints, calls that writer *a caviller about trifles*. But I must still maintain that the inference from Mr. Gilman's having stated that "the ends of the cylinders were accurately turned, and the cover and the bottom nicely faced *to joint with the cylinders*," is an important matter, and not a trifle, since it involves, as already pointed out, the important question, whether Mr. Gilman's generator was *ever put into operation*, as he asserts, or whether it is a mere pretended scheme, which had no existence even in his own brain till on or about the 5th of December, 1829.

The most sensible part of "S. Y.'s" letter is the question with which he concludes, and for which, I dare say, Mr. Gilman does not hold himself over and above indebted to his friendly ally. "I will conclude by asking Mr. Gilman, whether he had not better prove what 'A Practical Engineer' challenges him to prove, page 117, or give satisfactory reasons for not doing so, *and thus end the dispute?*"

By Mr. W. Butler, of Stockport.

As to the soreness which Mr. Gilman says the friends of Mr. Hall have displayed, I can only say, as far as I am implicated, that I am now quite unconnected with Mr. Hall, and that it is the cause of truth and justice alone that I advocate.

I assert that there is not the slightest positive or even presumptive proof of Mr. Gilman having, as he again affirms, *done in* 1826 what he publishes only on the 5th of December, 1829, and which was done by Mr. Hall in 1824 and 1825. Mr. Gilman has unwittingly committed

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a terrible blunder in his explanation. The plan, he says, which Messrs. Pearson and Witty proposed was briefly this: "to effect combustion under pressure, and to mix the products arising therefrom with the steam generated from water, by which the fire was to be surrounded. Now, Mr. Editor, this is precisely Mr. Hall's plan of 1828, *with the exception of no steam being passed through the fuel.*" "Precisely Mr. Hall's plan!" Why, Mr. Editor, I can tell you that all Mr. Hall's inventions and ingenuity would have availed him nothing, if he had not devised that most important contrivance for carrying away the heat as it is generated, *by passing steam along with the air through the fire*, thereby preventing such an accumulation of heat as would rapidly destroy any apparatus. I have seen strong iron fire-bars perfectly melted in a very short space of time when the steam has accidentally been omitted to be passed through the fire along with the air. I still say (notwithstanding Mr. Gilman has twice, in the same letter, stated to the contrary) that his plan of exhaustion will be productive of an artificial atmosphere and steam of decreased density to act in conjunction upon a piston. And to use the amusing language of "A Practical Engineer," I am sure that "all the fuel in the universe would not, if applied in this way, produce power sufficient to turn a piece of beef on a roasting-spit."

THE LONDON MECHANICS' INSTITUTION.

Sir,—Permit me to add my testimony to that of Mr. Cull as to the general incorrectness of the article on the adjourned meeting of the members of the London Mechanics' Institution, given in your 352nd Number. Your (to me) unknown correspondent has jumbled together an exceedingly incorrect account of the first and adjourned meetings.

I forbear to enter into minute details, but I enclose a correct account of what really did take place upon each occasion, from the *Morning Advertiser*.

In conclusion, permit me thus publicly to express my gratitude to Mr. Robert Reynolds, Mr. Cull, and their indefatigable coadjutors, for their spirited endeavours to rescue the London Mechanics' Institution from the odium which had been cast upon it by the misguided management of some portion of the committee.

As the butterfly can flourish only in the summer's sun, so will our institution thrive and prosper only in the sunshine of PUBLIC FAVOUR; any proceedings likely to estrange this patronage, are highly prejudicial to the interests of the institution.

I am, Sir,
Yours respectfully,
W. BADDELEY, Jun.

May 17, 1830.

[We regret that we cannot spare room for the long report from the *Morning Advertiser*, with which our esteemed friend, Mr. Baddeley, has favoured us; since it would have shown that after all, the errors in our "correspondent's" account are not worth cavilling about: none of them involve a point of the least consequence. We must notice, however, in passing a new feature in the business, which figures rather conspicuously in the report of our contemporary. It is stated in an introductory paragraph to this report, that "the rent for *all* public meetings," held in the theatre of the institution, has been regularly applied in liquidation of the principal and interest of the debt contracted for building it—*that is, in liquidation of the principal and interest of the debt owing Dr. Birkbeck.* A letter is afterwards said to have been read from Dr. Birkbeck at the first meeting of the members on this business, in which he gave as his reason for declining a compliance with a request made to him to preside on the occasion, "that he understood he *had been charged with sanctioning the Radical and other meetings for the purpose of getting his interest on the money he had advanced to forward the objects of the institution*, and he therefore wished to avoid filling a situation in which he might be exposed to a suspicion of partiality." And this charge of sanctioning the Radical and other meetings from pecuniary motives, Dr. Birkbeck is reported to have, at the adjourned meeting, "repelled with indignation." We do not find it, however, any where stated, that Dr. B. justified "the indignation" he professed to feel by a denial of a single one of the facts on which that charge rests. We do not see that he has ever denied, either in writing or verbally, that he has received *all* the money which has been gained by the application of the theatre to uses, which have been stigmatised by

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the late resolution of the members as discreditable and injurious to the institution. On the contrary, the fact seems to be explicitly admitted. Neither do we find it alleged that Dr. Birkbeck ever objected to receiving the money on account of the sources from which it was derived—ever remonstrated against the uses to which the theatre was applied—or ever took a single step to save the institution from the disgrace in which it was fast involving itself, through the expedients to which the managers were driven to satisfy Dr. Birkbeck's pecuniary demands upon it. While, therefore, such a case as this is left established against Dr. Birkbeck, of what avail is all his "indignation?" Dr. Birkbeck may not have, in direct terms, sanctioned the base uses to which the theatre was turned, but he did those things which, by all the ordinary rules of construction, implied such a sanction: one thing in particular, which we apprehend will be considered by all impartial persons as of itself decisive of the point—*he pocketed the price of the misappropriation*. Why is it that we press conclusions of such severity against Dr. Birkbeck? Not, we beg leave to assure our readers, from personal hostility to Dr. Birkbeck (whom we have spared quite as often as censured), but simply in justice to ourselves, in justice to the credit of our journal, and in justice to the objects of the institution. It will be remembered that we protested from the first against Dr. Birkbeck's thrusting the loan of his money on the institution; that we foretold most of the evil consequences which have flown from the proceeding; that we distinctly warned the members that if they built with any other money than their own, they would have to struggle through a course of difficulty, embarrassment, and subserviency, which would be fatal to the successful pursuit of those objects for which the institution was founded. Have our predictions been fulfilled, or have they not? What but the debt to Dr. Birkbeck has driven the managers of the institution upon those shifts which have brought them into such disgrace? And what but a tenderness for the interests of *Dr. Birkbeck, the Creditor*, could have made *Dr. Birkbeck, the President*, so forgetful of the interests of the institution? We farther beg our readers to recollect, that when at the last anniversary meeting of the institution, Dr. B. spoke in exulting strains of the "triumphant and prosperous" condition of the institution at that time, we affirmed that it was neither the one nor the other, and challenged Dr. Birkbeck to deny that "the number of members, of all sorts, was less by *several hundreds* than it was during the first and second years of the institution" (see "Mechanics' Magazine," vol. xii. p. 279). Was this challenge ever accepted? No. And how is the fact now proved to stand by the accounts produced by Mr. Clarke at the late meetings (see "Mechanics' Magazine," vol. xiii. p. 156)? Why, that during the year 1829, the total number of quarterly subscriptions was less by *eighteen hundred and forty-one* than in the first year of the institution, and less by *two thousand one hundred and ninety-three* than in the second year! We were strictly right, then, in affirming that Dr. Birkbeck at the last anniversary stated that with respect to the condition of the institution which he must have known not to be correct. Whether we were right in adding that "the exultation" of Dr. Birkbeck was "the make-believe shift of a man in a state of desperation,"—in terror for the fate of his "principal and interest,"—is a matter of inference which we leave to the judgment of our readers. We will only add, that when Dr. Birkbeck could pass over in silence the charge which we brought against him in November last, of exaggerating the state of the institution for the sake of his bond, the "indignation" which he now affects to feel at the thought of being charged with sanctioning the means by which money has been obtained to pay the interest of that bond, is somewhat out of place. The time for being indignant went past, when the Doctor chose to go to sleep on a charge of violating truth, to conceal mismanagement and prolong its reign.—ED. M. M.]

FINAL DECISION OF THE COMMITTEE OF THE LONDON MECHANICS' INSTITUTION ON THE SUBJECT OF THEATRE-LETTING.

Sir,—Since I last addressed you upon the subject of the late meeting at the London Mechanics' Institution, I have had the pleasure of learning that the Committee of Managers have taken into consideration the resolution carried at that meeting (see p. 175); and after much able and animated discussion, it was decided, that the theatre *should not in future be let to any parties for political or religious meetings*. All applications for the use of the theatre will in future be referred to a sub-committee, who will decide whether the purpose

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for which it is required, comes under the head of either of the prescribed topics, or no.

Such a termination of this unpleasant affair cannot but give hearty satisfaction to every well-wisher of this valuable institution.

For my own part, I sincerely hope, and confidently anticipate, that a considerable accession of *new* members, and the return of many *old* ones, will follow the settlement of this long-agitated question.

With the most ardent wishes for the continued prosperity of the London Mechanics' Institution,

I remain, yours respectfully,

WM. BADDELEY, Jun.

May 20, 1830.

LATH AND PLASTER PARTITIONS—THE LATE FIRE IN FETTER-LANE.

Sir,—The remark of your valuable contributor, Mr. Davy, in your last Number, on the non-conducting power of lath-and-plaster partitions, is calculated to produce (unintentionally, I am sure) rather an injurious impression upon the minds of many of your readers. These partitions should, as far as is possible, be done away with, and superseded by some wholly incombustible material.

Mr. Dudley, speaking on this subject in "The Tocsin," has the following suggestion:—"If you wish to be even more safe, use *hoop-iron* for lathing, it is cheap enough."

The lath-and-plaster partitions in Fetter-lane, to which Mr. Davy alludes, were preserved, not by their own non-conducting property, but by the falling of the building before they had become exposed to the action of the flames.

On the arrival of the firemen in Fetter-lane, from the head the fire had attained, and from the combustible nature of the adjoining premises, they anticipated an extensive conflagration; and, accordingly, they put a great number of their engines into active employment as quickly as possible. The fears of the firemen were, however, agreeably dispelled by the early falling of the building, from the supporting-timbers having been burnt through; the firemen took advantage of this circumstance, and kept up a continual stream of water upon the sides of the two adjoining houses, from which the fire had been, as it were, withdrawn.

Great praise is due to the firemen for their meritorious exertions; but, their endeavours would not, in this instance, have proved so successful, had not the circumstance briefly narrated above, given them so unexpected and important an advantage.

I sincerely hope that all the wooden buildings which remain of "London in the olden time," will be speedily exchanged for those of a more incombustible description; but, I also hope this change will be effected by some less terrific agent than fire.

I am, Sir,

Yours respectfully,

WM. BADDELEY, Jun.

May 18, 1830.

THE SOLUTIONS OF MR. LUCOCK'S MECHANICAL PROBLEM.

Sir,—You remark, in the preface to your 12th vol. "that cases may be readily imagined where Mr. Hughes' solution of Mr. Lucock's mechanical problem would not apply;" I must humbly beg leave to state that I am of a different opinion, for I cannot conceive that a single case could be produced but what could be solved by one or other of his methods.* The truth is, that both gentlemen have given good solutions. When the perpendicular BF (see Mr. Hughes' solution, No. 338) falls within the rectangle ABCD, which will always be the case when AB is not greater than 2 AC, I would give the preference to his (Mr. H.'s) first solution; but when AB is greater than 2 AC, I would give Mr. Dowling's solution the preference, because he does it with three cuts, and Mr. Hughes' second construction requires four. It may, however, be stated, that the question (I do not mean the solutions) has no pretensions to originality. For it is to be found in "Bonnycastle's Arithmetic," and is solved by him in the "Key." This solution, however, is much inferior to that of either of the above-named gentlemen. A similar question is also given in the "Tutor's Guide" (or Misguide), and something like an Irish solution

* Perhaps so; *one* or *other* of his methods." But if our esteemed correspondent will refer again to our remarks on the subject, he will perceive that we spoke merely of the one method in which the operation was performed by two cuts. —ED. M. M.

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is given for it in the Key* (I refer to the ninth edition). Before dismissing the subject, I would suggest to Mr. Dowling what I conceive to be an improvement in his construction.

Let ABCD be the given rectangle, of which the side CB is greater than AB, &c.

Find CG, a mean proportional between AB and BC (see his own diagram); make AN = GC, join BN, and through G draw GC, parallel to AB. Then may the three cuts or sections ABN, BGA, DNHGC, be so joined as to form a square.

A slight modification in Mr. D.'s demonstration will make it apply to the above construction.

Mr. D. will at once see that this is an improvement, for no lines are required to be drawn out of the given rectangle.

Yours, &c.

ZENO.

NEW STREETS.

Sir,—In consequence of the bill, which was brought last week into Parliament, for a new street from Waterloo Bridge to the north side of the metropolis, permit me to submit through your pages to those gentlemen who have the management of the bill, whether the suggestion which I made in No. 344, for a new street from Oxford-street to Holborn might not be advantageously united with it. To the benefits I then enumerated which would result from such an improvement, I beg to add that a respectable communication might thus be formed between the large squares and private streets on the east of Tottenham-court-road and those at the West-end; while such a communication with the new street to Waterloo Bridge would make that the most respectable and direct way into Surrey, past the Elephant and Castle, for all parts north of Oxford-street.

The importance of these streets as communications with the British Museum, which by the way is about centrically situated between the two Universities, ought not to be overlooked. If these improvements were accomplished, parents, whose sons might attend either college, might find convenient residences in the squares and streets between Great Russell-street and the New-road, where they could watch over them during their education.

The revenue arising from bricks and tiles was stated in *The Times*, a short time back, to have been in 1828 about £368,538. If government intended to lend a helping hand to these or any other similar improvements, probably they cannot do it better than by taking off the brick duty. It will be a great pity if in either of the streets above referred to, any houses are permitted to be built without some of those means of security from fire, which can easily be accomplished by being attended to.

Yours, &c. C. D. S.

INTERIM NOTICES.

On Saturday next, the Editor of the "Mechanics' Magazine" will commence a new weekly Journal, to be called the "SPIRIT OF LITERATURE." It will be conducted on a plan, in many respects, entirely new; and be distinguished more especially for its cheapness and comprehensiveness. A gratis copy of No. I. will be sent to each of the Subscribers to the "Mechanics' Magazine," and to that specimen the Editor begs to refer for a developement of the grounds on which he confidently hopes for their unanimous support to this new undertaking.

The New Set of Logarithmic Tables which we announced in the Preface to our last Volume as being in the hands of the Printer, are now completed, and will be included in the Quarterly Supplementary Number to be published next week. We believe they will be found the most concise ever published, yet comprehensive enough to answer all ordinary purposes. They are accompanied by an Explanation of their Arrangement and Use, and numerous Examples. The gentleman to whom we are indebted for this valuable contribution to our pages, is J. W. Woollgar, Esq., of Lewes, of whose skill in the science of numbers, our readers have before had many valuable proofs.

Communications received from Nauticus—B. H. L.—A Constant Reader—A Friend not a Baker—S. E. G.—Mr. Sims—A Young Bookbinder—A. Reyevrus—J. M.—Mr. Barnard.—J. B.—Mr. Bennet—Saxula.

Errata in last Number.—P. 170. col. 1. l. 15. for "with what were called plates similar to what is known by the name of parquetting," read "with what were called plates, coated with a composition similar to that known by the name of pargetting."

P. 171. col. 1. last line, for "strong posts," read "story-posts."

* I have been induced, in consequence of the remarks made in your 346th Number by Jonathan Dawplucker, to examine the "Key," and I must confess that what Jonathan states is too true. I have also discovered several gross errors which have escaped the notice of the scientific Dawplucker.

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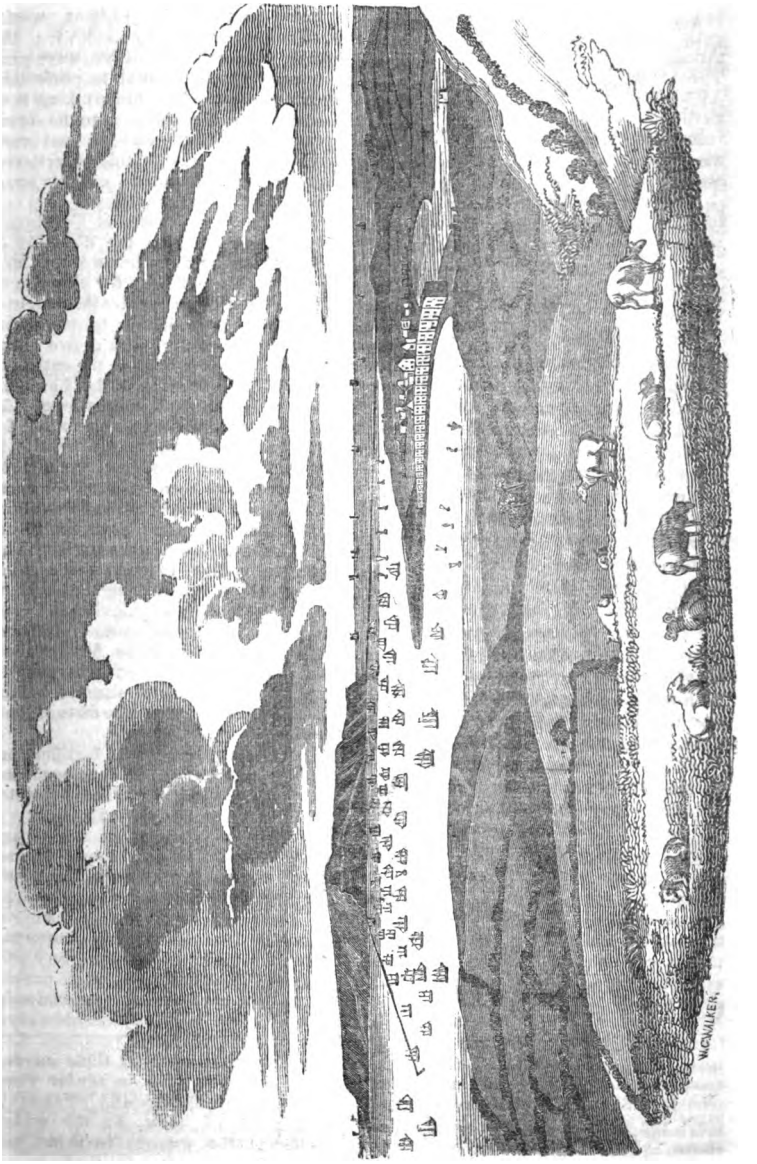
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 355.] SATURDAY, MAY 29, 1830. [Price 6*d*.

VIEW OF THE TOWN OF WEYMOUTH AND THE PROPOSED BREAKWATER AT PORTLAND.



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THE PORTLAND BREAKWATER.

" ——————— the billows sleep
Within the shelter of a wondrous pile
Of man's vast workmanship—that new-made isle,
That marble isle—brought piecemeal from the shore,
To break the weltering waves, and check their savage roar."

GANDY.

Among the communications recently made to the Institution of Civil Engineers, was a paper of remarks "on the subject of a breakwater in Portland Roads, projected by Mr. John Harvey, Engineer," (whose death we recorded in our last Volume (p. 208), accompanied with a chart of part of the Channel, showing the relative bearings of Portland to Portsmouth, Plymouth, and Cherbourg, and some supplementary remarks by Mr. John Harvey, Jun., Postmaster, Weymouth. We know of no project of national improvement of more decided and extensive utility than this of the Messrs. Harvey (we may well say the *Messrs.* Harvey, for though Mr. Harvey, the father, was the original projector of the plan, Mr. Harvey, the son, has connected himself not less essentially with it, by his indefatigable endeavours to bring about its accomplishment); and in the hope of being of some assistance in obtaining for it that public attention and patronage which it so eminently deserves, we now lay before our readers the communications made on the subject to the Society of Engineers, along with some additional illustrations and documents with which we have been kindly favoured by Mr. Harvey, Jun.

1. *Remarks by Mr. John Harvey, Sen. on the subject of a Breakwater in Portland Roads.*

The progress made by the French nation at Cherbourg in completing a capacious harbour and safe roadstead, as well as several docks for shipping, of the largest dimensions, has for more than a century been an object of attention and consideration to the British government. As early as 1687, Louis XIV. formed a design of enlarging and fortifying that place and harbour, which was done at intervals. In 1758, it was considered by our government as of no trivial consequence, and likely to become the cause of so much danger and alarm, that an expedition sailed under the command of the late Earl Howe, which destroyed nearly the whole of the works. Immediately after the preliminaries of peace were signed, in 1783, the views of the French were again directed to Cherbourg; and by renewed exertions, they have at length established it as a naval arsenal of the first consequence.

Some part of the present works were commenced by Louis XVI.; the greater proportion, however, were executed and nearly brought to perfection by Buonaparte. The undertaking is of a magnitude very difficult to be comprehended by those who are not conversant with works of this nature, and therefore an attempt to convey some idea of it is highly necessary.

The grand breakwater at Cherbourg was commenced under the direction of Doumourier in ten fathoms water, and allowing about 30 feet for the rise or flow of the tide, it required a structure of 90 feet perpendicular to attain the level of high-water mark; five times the height is calculated as the extent of its base. The breadth at the base will therefore be 450 feet, and at least 4134 tons of stone may be calculated for every yard in length, or to erect it at low-water mark, not less than 1946 tons must have been required for every yard. A part of the breakwater is above high-water, but some parts of it are barely up to low-water mark. This immense edifice extends three miles from east to west, fronting the harbour, and at a moderate calculation must have required the enormous quantity of 10,274,280 tons of stone, for the most part quarried for the express purpose from a hill of granite situated behind Cherbourg, about one mile distant from the shore.

In addition to this work, fortifications on a very extensive scale have been carried on, and a naval arsenal completed with numerous docks, sufficiently capacious to admit ships of the largest class; these works have been all formed out of the solid rock near Fort Hommet, a mile distant from the old works.

The national advantages to the French, in time of war, of the important situation of Cherbourg, are very considerable, by affording adequate protection to their naval and commercial shipping, and enabling them considerably to annoy the English.

In order to counteract these important objects, I propose to render Portland Roads complete and efficient in every point of view, on the system adopted on the opposite coast at Cher-

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bourg; viz. by the construction of a breakwater, as exhibited in the plate, which introduces the proposed line, with the adjacent coasts, shipping, &c. and I trust will convey a just and comprehensive idea of its appearance when the desired work shall be effected.

It should extend from the north-east point of the island to a distance of two miles and a quarter, which would secure a safe anchorage, and form a roadstead of four square miles in extent, situated only 21 leagues north of Cherbourg, and would doubtless prove the best and most complete shelter during all winds in the British Channel. Its central situation between Portsmouth and Plymouth, would form a most effective counteraction to the naval armaments of Cherbourg.

The excellent anchorage in Portland Roads, consisting for the most part of strong blue clay with scarcely any tide, is too well known and appreciated by mariners, to require any comment; a fleet of sixty sail of the line would be in perfect safety during every vicissitude of wind and weather, and be enabled to go and from sea at discretion. There are numerous springs of excellent water contiguous to the proposed breakwater, sufficient for the use of the whole British navy, if required.

The reason for proposing two miles and a quarter for the length of the breakwater, in preference to any shorter distance, is, that it will completely shelter Weymouth Pier, Harbour, and Bathing Place, when it blows hard from the south-east. The point of termination will then be near the remaining part of the wreck of the unfortunate Abergavenny; and it is a matter of no little moment, that a vessel may from that point clear Portland with the wind at south-east, without making a tack. This necessary position can be more readily gained by vessels working up to it under the lee or shelter of the breakwater than when exposed as at present, to the full power of the unobstructed sea, and which, if the breakwater was of shorter extension than two miles and a quarter, they would still have to contend against.

It is remarkable that although the breakwater and works at Cherbourg were thirty years in the execution, a work of greater magnitude as a capacious roadstead, might be undertaken and accomplished at Portland within a period of *five years*. It may be asked, how can this assertion be satisfactorily proved? I answer, that the island of Portland affords stones already quarried, to be obtained gratis, in any quantity and for this obvious reason, there are in the space of one mile of quarries no less than twenty million tons of stone already prepared, and which may be taken away; this is five times the quantity of material more than is required to complete this useful and important undertaking; and further to elucidate the subject, the stone most proper for the purpose of the breakwater, is that termed the cap-stone, which is not of a marketable quality for architectural use, and is generally hard, rough, and shelly. I will now endeavour to explain how it is that stones in such immense quantities are to be obtained already prepared, and so extremely well calculated for such a work. It is required in order to work the quarries, to remove on an average 14 feet thick of the upper, or cap-stone, ere it is possible to arrive at the layer, or bed of the fine, saleable stone; this broken-up cap-stone becomes a great and extensive encumbrance, and the utter ruin of the ground it occupies: the immediate benefit arising from its removal would be the restoration of the land, and this, it is obvious, would lessen the price of stone—a price, in fact, having already been given by the public for this saleable stone, covering the whole expense incurred in breaking up the cap-stone, which has been collecting for centuries past. The railroads required for its conveyance from the quarries to the wharf or shipping-off place would be an accommodation of no small consideration to the merchants, because, the rail-roads can remain for their use when the breakwater shall be finished.

The elevation of the quarries is upwards of 300 feet above the level of the sea, so that railways might be constructed on proper inclined planes to convey the stones to the water-side without aid from either engines or horses; in consideration of all these advantages, and in every point of view, the erecting a breakwater in Portland Roads will be attended with only one-fourth the expense of such a work, if erected in any other part of the known world.

The proposed design from its central situation in the British Channel will afford more extended advantages in the event of stress of weather, to the kingdom at large, than any similar undertaking, there being no other port in which ships can ride with perfect safety between Portsmouth and Plymouth; it will also afford a secure asylum to the merchant service in time of war, as well

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as form a most complete and efficient naval station, especially to watch the movements of the enemy. Fleets of every description could then, at all times and seasons, and during all winds, rest perfectly secure, admitting their magnitude to be as great as any that ever sailed from the shores of Britain.

The Channel off Portland on the English side, and off Cherbourg on that of the French, is the main passage for all vessels coming to England eastward, and going from it westward; it has been ascertained, that during fine and clear weather, that a vessel mid-channel can command a sight of Cape la Hogue, Alderney, Portland, and the Isle of Wight. If a squadron in war time should put to sea from Cherbourg, intelligence of the circumstance could be conveyed to Portland (by looking-out vessels, stationed at certain distances across the Channel) in one hour and a half, or in a less period, if the wind be favourable.

The reflection is melancholy, that for want of such a central rendezvous and safe retreat for the shipping, numerous and most serious disasters have occurred within my recollection. On the 6th of January, 1786, the Halsewell East Indiaman was lost near St. Alban's Head, and only a few of the crew were saved;—this fatal event was occasioned by the commander's endeavouring to gain Portsmouth in order to repair the damage the masts had sustained westward of Portland.

In November, 1795, Admiral Christian, with a fleet under his charge, bound to the West Indies, by attempting to gain Torbay in preference to returning to Portsmouth, met a similar fate on the West Beach, near Portland, when many transports were lost, and it is said, that a thousand persons perished.

In February, 1805, the Abergavenny East Indiaman attempted to gain Portsmouth, after having unfortunately struck on the Shambles, but the leak proving of too serious a nature, it was found impracticable, and every endeavour was made to reach Portland or Weymouth Roads, but without avail; for when within a short space of gaining a place of safety, she sunk in 9 fathoms of water, and about 300 persons perished.

The storm of November, 1824, the most terrific ever known, is another strong case, proving the actual need there is for the construction of a breakwater; had it then been built, its great and extensive utility would most strikingly have been displayed, both as affecting the shipping, and by the protection of Weymouth itself; for the pier and esplanade, which were both nearly destroyed, and have since been re-built, must have been wholly preserved.

In the event of a bridge across the ferry, which the population of Portland (about 2300) seems to require, a breakwater would form a noble protection against the ill effects of a heavy sea.

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2. *Additional Remarks by Mr. John Harvey, Jun.*

It has been observed by a friend, that a mind capable of forming such a design and of rendering it practicable, could never willingly abandon it; this was literally the case with regard to my father.

The idea of a breakwater in so central a point of the British Channel originated with himself in 1794; since which period to the close of his life, he strictly watched the progressive advancement of Cherbourg up to its present importance, and constantly availed himself of every possible means of representing the matter where it was likely to obtain the attention which the subject so highly deserves, as well as in maturing his plans to carry it into effect in Portland Roads, and thereby to afford an efficient counteraction to the opposite port of Cherbourg.

It now devolves upon me to prosecute to the utmost of my zeal and ability this most important national object, more especially as it has made considerable impression in the public mind.

The great exertions which both France and America are at present making in the formation of their respective navies, should not be overlooked by our own Government, which cannot, in this respect, be too much on the alert. France is trying every experiment not only in the instruction and constant practice of exercising a large body of men as seamen, but in a new system of artillery, which in the event of a war, will, to say the least of it, give us more trouble than we have ever experienced in either single or general engagements with the French afloat.

I am most anxious not merely to continue, but also materially to enlarge upon the necessity of a breakwater for Portland Roads.

In advocating this subject, let it not be supposed that I am labouring to excite a spirit of military or naval enthusiasm, or recommending an arsenal for the purpose of enabling us to engage in

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new wars; on the contrary, I would be the first to deprecate this spirit, a spirit to which the world owes, as long as we can trace its history, all the public afflictions, distractions and revolutions by which it has ever been visited; but so far from thinking, that a naval arsenal at Portland Roads, opposite to that of Cherbourg, would be an inducement to war, I submit that it would be the most effectual means of putting an end to every species of traffic in human blood.

The great power which Cherbourg now enjoys is evidently a temptation to an ambitious king, or intriguing minister, to go to war, and the more England is prepared to oppose the ambitious designs of France the better. It might probably be good policy in England and France to remain at peace, and to unite their mercantile interests, in order to overawe the ambitious designs of neighbours; but it must be remembered whatever is gained by France, in a warlike command over the British Channel, must unquestionably be so much lost to England, as the great and important thoroughfare of the British Channel is connected both with her naval and mercantile interests. It was observed by the great Lord Rodney, of glorious memory, in a letter to Governor Thicknesse, dated Bath, 1787, "If Cherbourg Harbour is completed, then the British Channel is no more; it will be the French Channel." Of the truth of this remark the French appear, by the extent and solidity of their works, to have been well aware from the beginning.

Before the breakwater was erected at Cherbourg, by which immense structure that port has become so formidable, England had greatly the advantage of France, because the intervention of the national harbours of Portsmouth and Plymouth between Brest and Toulon, obliged France to fit out the whole of a fleet at one or the other of those ports; and as no French national harbour then intervened between Portsmouth and Plymouth, much valuable time was saved in fitting out a part of the British fleet in each of those harbours. From the great importance which Cherbourg has attained, France is now placed, in this respect, in the same point of view in which England has hitherto been.

In a report which M. de Vauban made to the French government, he gave it as his opinion that the roadstead of Cherbourg possessed the means alike of protection, of attack, and of defence; that it was capable of exerting an important influence also in war, and on the commercial ralations with the northern powers; that it was the spot of all others on which the head-quarters of the French should be established on the coast of the Channel; that it was a central advance post with regard to England; and that, moreover, it might be made a port for the safe retreat of a squadron crippled by storms, or beaten by an enemy, as well as for the reception of *a victorious fleet* with prizes.

The fortifications for the protection of the anchorage in the roadstead, and the naval arsenal, are Querqueville, 30 guns; Fort du Homet, 65 guns; Fort Gallet, 80 guns; Fort Royal on the Isle Pelée, 80 guns. Fort Royal and Fort Homet have circular faces towards the sea, with each two tiers of guns, and turrets above them; the principal channel from the road to the sea is at the western end of the breakwater, and a fleet may push out to the westward in southerly winds, which lock up the English ports in the Channel.

In addition to the breakwater, two immense basins, building-slips, and the docks connected with them, have been completed. The basins are for the most part excavated out of granite rock, one is 30 and the other 60 feet deep; the ships are launched into, and docked out of the smaller one, which will contain about 16 sail of the line; the larger basin, 1000 feet in length by 770 in width, is for the fleet when ready for sea, in which 24 sail of the line can be moored with the greatest ease, by means of anchors inserted in the granite, and when required, can be at sea in a few hours. The two basins communicate with each other, and with the harbour: a basin for merchant-ships was also completed in 1829. A narrow canal between the walls of Fort Homet and the wall of the wet-dock leads to a most convenient space for mast-ponds and mast-houses. The covers over the slips and docks are on a grand and magnificent scale; they are erected on granite piers, with the roofs constructed on a most excellent principle, and executed in a very superior style; they are regularly slated, each roof having a number of rows of lights, each row containing 27 windows. The building of large ships at Cherbourg has been proceeded with in a very rapid manner; no less than 8 three-deckers were launched at the arsenal during 1827; and two other three-deckers, 2 ships of 100 guns on two decks, several frigates, and large steam-boats, were on the stocks in the same year.

The erection of the breakwater pro-

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posed in Portland Roads would restore the former superiority of England, by doing away the greatest part of the advantages which the French engineers have anticipated for France, from the great strength, resources, and commanding central position of the port of Cherbourg; and what is more, in all probability, this great advantage could not again be destroyed by France.

The highest part of Portland is 490 feet 3½ inches above high-water mark; St. Alban's Head, the farthest land in sight to the eastward, about 20 miles distant from Weymouth, is also of great importance to mariners, constituting a landmark rising 440 feet perpendicularly above the level of the sea, with an extent between it and Portland of 6 or 7 leagues; perhaps there is no other bay in the world which can afford equal shelter and accommodation, as Portland Roads (to use a nautical phrase) *may be made* notwithstanding any change of wind.

The breakwater would secure to the navy of England the full and uncontrolled sweep of the British Channel, presenting a middle station and refuge between Portsmouth and Plymouth in a harbour of *four square miles*, surrounded by superior facilities for dock-yards, ship-building, military arsenals, depots, provisioning and refitting, with a certainty of getting to sea at any moment. Vessels would be quietly moored during all gales without tide, a most decided advantage, by enabling them to ride head to wind, unexposed to the sea; whereas, at present, they pass by Portland when it blows hard, seeking that protection which so many have sought for in vain. To merchant-vessels, East and West India shipping, &c., it would be highly advantageous, whether as a central place of trade, or place of shelter; in truth, the structure proposed would be found not only a naval protection for shipping in time of peace, but a national bulwark, an unassailable intrenchment in time of war.

It may be said, no doubt, that we are always a match for France, without seeking protection from any such national bulwark as the proposed breakwater for Portland Roads: but I answer, that if the affray is once begun, we can never quell or defeat France in her ambitious aims, without sacrificing the lives of some thousands of our countrymen, and becoming ourselves the butchers of some thousand Frenchmen. Were a breakwater with its appurtenances once constructed in Portland Roads, here would be a naval station, from whence the movements of Cherbourg might be distinctly watched, as well as merchant ships and vessels protected from that injury and insult to which, from the advanced situation of Cherbourg in the British Channel, they must otherwise be invariably exposed.

Nor is it only to British navy and British commerce that a complete rendezvous in so central a situation becomes an object of concern; for the whole nautical world, all at least, whose traffic or pursuit invite them up or down the British Channel, must feel the great utility of such a station; and surely it were a project worthy the honour of our warlike and commercial island, the empress of the seas, to establish an asylum not only for her own navies, but for those of the whole world, friends or foes, when occasional distress might drive them undesignedly upon her coast.

The important and extensive advantages which nature has so bountifully afforded at the island of Portland, forms a very material inducement for undertaking this great national object.

Owing to these local advantages, it could be performed at much less expense to the country than any public work whatever, the expenditure consisting of very little more than the carriage of the waste cap-stone upon railways from the quarries, &c., to the wharfs and lighterage, from thence to the line of the intended breakwater. The Portlanders have already prepared the materials of waste cap-stone in an immense quantity, enough for 30 miles of breakwater; in short, the immense store of ready-made waste cap-stone, extremely well adapted for the intended work, is inexhaustible.

It is calculated, that if the railroads, lighters, carts, &c., be arranged in the most efficient manner, in due proportion, so as to dispatch the work at the rate of 4000 tons per day, say for 260 working-days in the year, (allowing 105 days for Sundays and bad weather), the construction of the breakwater would employ several thousand men for five years. Even while the work is being performed, the public will be benefited, because the whole expenses incurred by the undertaking will be returned back to the very public who pay it in the first instance. By finding employment for labourers, we not only lessen the poor-rates, but the agriculturist finds a better price for the fruits of his labour.

In the apparent multitude of these good things, Weymouth as well as Portland and their neighbourhood would

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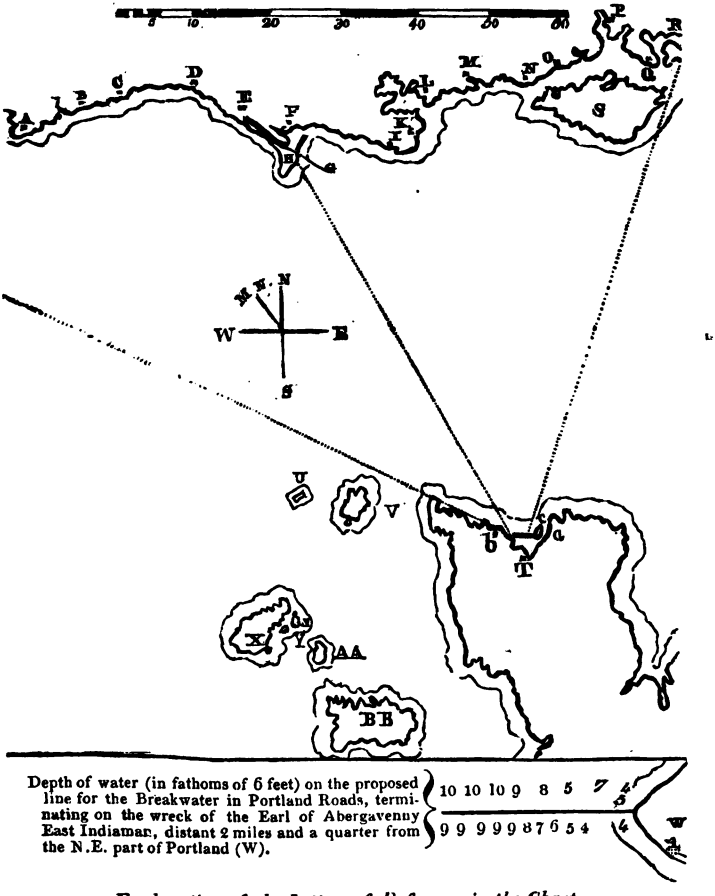
reap an abundant harvest, in the profit inseparable from an immense influx of naval, military, and mercantile visitors, besides an addition of fashionables invited by the still greater improvement to the bathing accommodation; while the breakwater itself would form a gay, healthful, busy, and delightful marine promenade, with a harbour perhaps the most extensive and accommodating in the world; attractive for safe and convenient sailing parties.

To this great national improvement, there does not appear, in short, any drawback or insurmountable impediment whatever. Immense advantages, both general and local, would arise from it; and perhaps the future safety of the country may depend on its adoption.

3. *Chart of the Channel, showing the relative Bearings of Portland, Portsmouth, Plymouth, and Cherbourg.*



Depth of water (in fathoms of 6 feet) on the proposed line for the Breakwater in Portland Roads, terminating on the wreck of the Earl of Abergavenny East Indiaman, distant 2 miles and a quarter from the N.E. part of Portland (W).

10 10 10 9 8 5 7 4
9 9 9 9 9 8 7 6 5 4 4

Explanation of the Letters of Reference in the Chart.

A. Exmouth. B. Sidmouth. C. Lyme. D. Bridport. E. Abbotsbury. F. Weymouth. G. Proposed Breakwater. H. Portland. I. St. Alban's Head. K. Swanage. L. Poole. M. Christchurch. N. Hurst. O. Lymington. P. Southampton. Q. Gosport. R. Portsmouth. S. Isle of Wight. T. Cherbourg and its Breakwater, distant from Portland Roads by compass 21 leagues; from Plymouth Sound, in the direction indicated by the dotted line on the left, 36 leagues; and from Portsmouth, as indicated by the dotted line on the right, 29 leagues. U. The Caskets. V. Alderney. X. Guernsey. Y. Jethou. Z. Herm. AA. Sark. BB. Jersey; *a*, Castle and Isle of Pelée; *b*, Querqueville Point and Fort.

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The additional illustrations and documents which follow are those which have been furnished by Mr. John Harvey, Jun.

4. *View of the Town of Weymouth and the proposed Breakwater.*—An engraving of this is given on our front-page, and requires no explanation. It does great credit to the graphic skill of our engraver, Mr. Walker.

5. *Letter by Captain Joseph Bennet to Mr. John Harvey, Jun.*

[The testimony which Captain Bennet here volunteers in support of the undertaking is peculiarly valuable. It is that of a practical man, evidently of great acuteness and intelligence, who has spent the better part of a long life in the navigation of the Channel, and must, therefore be well qualified, by his local knowledge and experience, to give a sound opinion on the subject.]

Letter from Captain Joseph Bennet to Mr. John Harvey, Jun.

Dear Sir,—From 1758 to 1804 (46 years) I was engaged in a seafaring life, and it is well known to yourself, as Post-master of Weymouth, as well as by all the inhabitants, that nearly 12 years previous to my resigning I commanded the *Rover*, one of his Majesty's post-office packets between Weymouth, Guernsey, and Jersey. I have naturally, in the course of my various voyages, been exposed to many a gale of wind, and have experienced many dangers of the seas; but, thank God, I have survived them all! I have resided, ever since my retirement, at Weymouth, where I have had an opportunity of remarking the various improvements that have taken place; and now, with your leave, I shall give you my own opinion relative to your proposed breakwater for Portland Roads.

While I commanded the *Rover* packet, and, indeed, many years before, I always entertained a strong conviction that Portland Roads might be rendered far superior to the port of Cherbourg, and, some time back (although now in my eightieth year) I would, with pleasure, have devoted both heart and hands to exertion in so desirable a national work.

It is obvious that many ships and valuable lives would be continually saved, if their commanders were to run for that protection which a breakwater in Portland Roads would afford. I well remember running safely through Portland Roads on my homeward voyage from Jersey and Guernsey, in the *Rover* packet, and landed the mail at Weymouth, during the latter part of *the same gale* in which Admiral Christian's fleet suffered so much loss on the west side of Portland by endeavouring to gain Torbay. I have also often anchored in Portland Roads in southerly gales, and thereby preserved the packet, myself, crew, mails, and passengers. It is, however, only during westerly and southerly gales that it is, at present, a place of safe shelter; for, with a gale from E.N.E. to S.S.E., it requires a breakwater to render it equally secure. In the gale in November, 1825, I was a passenger on board the *Hinchinbrook* post-office packet, commanded by Captain Quirk, with several other passengers and mails bound to Guernsey and Jersey. We anchored in Portland Roads before dark, and counted 24 other vessels there also; at 12 p. m., we drove with both anchors a head, and the whole of both cables out to their extreme ends, expecting, from the great violence of the tempest, to part cables every hour, or to drive on shore with our anchors; but, thank God, we rode out the gale. Several other vessels were, however, drove on shore, and became wrecks—one under Sandsfoot Castle, others upon the north shore. A brig (the *Nancy*) cut away her masts, which, with good seamanship, enabled her to ride out the gale, although she had drifted very near the shore. This unprecedented gale blew from S.S.W. to S.E. and by S. and veered back again to S.S.W., which drove the sea into Portland and Weymouth Roads, destroying Weymouth Pier at the entrance of the harbour, as well as a small pier within it, and the greater part of the esplanade wall. *If the breakwater had then been erected*, the piers, vessels, esplanade, and some lives would have been preserved.

I am persuaded if our government only knew the great advantages to be derived from Portland Roads for

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the accommodation of shipping, and the furtherance of all maritime business, they would lose no time in giving orders to prepare for so desirable a structure as the proposed breakwater.

If Portland Roads were converted by government into a naval port, it must become one of the first order in England; for the others, after taking every point into consideration, would not equal it in magnitude, as regards docks perhaps excepted.

It is probable that government, from the expense attending the Plymouth Breakwater, might be of opinion that the one proposed for Portland Roads would cost a like sum, or more; but it is a most gratifying consideration that, although *two miles and a quarter in length*, it will be less by many thousand pounds; neither would it require so long a time in its execution as that at Plymouth.

There is abundance of space from the west or inner side of the proposed breakwater to Portland Castle, to erect store-houses of every description, as well as for carpenters, rope-makers' yards, &c.; a never-failing supply of excellent spring water, and an unexhaustible bed of shingles for ballast, &c.

It is with much pleasure I can adduce for your satisfaction, as well as encouragement, to persevere in this great national cause, the opinion of our late most gracious Majesty George the Third and his advisers, 'that there was no such commodious bay as that of Portland and Weymouth to St. Alban's Head in this kingdom.'

Recourse was accordingly had to it for his Majesty's health and recreation; the royal yachts, ships of war, and a post-office packet, attended almost daily, when the weather permitted, during the royal visits at Weymouth; sailing, sometimes, far out in the Channel thoroughfare, to enjoy the novelty of seeing vessels outward and homeward bound, or to breathe the fresh air of the sea. And the various highly respectable officers who were in command upon those occasions will no doubt, if referred to, agree with me, that there wanted but a breakwater to render the bay as secure as it is commodious.

Such a breakwater would also create *a harbour of four square miles!* What a magnificent and national rendezvous would thus be afforded to England, in the very centre of her Channel thoroughfare!

I venture to say, that it would contain more ships of war than double the number, both of Cherbourg and St. Maloes. There is but little current, which circumstance adds greatly to its superiority as a harbour for the safety of shipping; they would lay head to wind, with most superior holding ground for anchors, and an abundance of sea-room for ships to tack about, &c. free from rocks. Ships might accordingly run in there boldly during a dark night, guided by the Portland lights, and by an additional light, which I would recommend to be erected on the outer or north end of the breakwater; going to anchor in the greatest safety, and having it even in their power to proceed again to sea in the night, which is more than they can do either at Spithead or Plymouth, as neither the Needles nor the Edystone light are sufficient lights for such a purpose.

I now proceed to some material points of the subject; and as they bear forcibly upon our own naval movements in time of war, as well as that of the French, I claim your attention thereto. If a French fleet were equipped and ready to sail out of Cherbourg and St. Maloes, and another fleet were ready to sail from Brest, you would ask my opinion what England would do in such an emergency? Why, Sir, I would station a sufficient number of ships off Cherbourg, St. Maloes, and Brest, and have them remain as long as wind and weather would permit them to keep their station, and when from the continuance of the gale they could no longer keep to sea, I would have them run for a good roadstead. Suppose the gale at S.W. and S.S.W. the English fleet off Brest would run to Plymouth, that part of the fleet off St. Maloes, for Jersey or Guernsey, and those off Cherbourg, for St. Helen's Road, or Spithead. Now, Sir, observe, St. Helen's Road is *not* a safe roadstead with a southerly wind; and Spithead, in a dark night, could *not* be made in a gale; nor even

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St. Helen's Road with the same safety and convenience, with which vessels might make the inside of a breakwater in Portland Roads, owing to the want of sufficient lights to direct them. Allowing the gale mentioned from S.S.W. to S.W. to be abated, and our fleet to be again arrived at their stations, a frigate would probably be despatched as near to the entrance of Cherbourg as practicable, to view the number and force of the French fleet therein, and their state of forwardness. Suppose the report brought back to be, that the force in Cherbourg is more than a match for the part of our fleet off that station, and that the wind at the time is blowing a gale from S.S.W. but not too strong for the French fleet to put to sea upon an emergency (the wind at S.S.W. being an off-shore wind, as it regards the French coast), they might come out and sail down the Channel without our being able to muster a force sufficient to oppose their progress. I find by this, it is of the greatest importance always to have a fleet of sufficient force to that of Cherbourg inside the breakwater in Portland Roads, where no sea could injure them.

Again, suppose a fleet were stationed at Portland to watch the enemy's fleet at Cherbourg, although not of equal force, how soon could it, in the event of the latter putting to sea, be reinforced from Plymouth, if the wind were westerly, or from Portsmouth if easterly? Suppose, on the other hand, a fleet of inadequate force were stationed off Cherbourg, and reinforcements were only to be procured from Portsmouth or Plymouth, how easy would it be for the enemy, with the command of the centre of the Channel, to prevent the junction of our scattered divisions?

Again, if our fleet from Plymouth be off Cherbourg with a strong wind at S.S.W., ships at Portsmouth could not join them for a considerable period, even if they were to attempt the risk of getting to sea, whilst from Portland they might do so much sooner.

Once more, if the whole of the British fleet, acting against Cherbourg, are at Spithead, the French fleet at Cherbourg might put to sea with an off-shore wind, as before described, without interruption on our part: this is a very corroborative proof of what I have said, that there is no such efficient position, with regard to Cherbourg, for an English fleet to watch the movements of the French in that port as at Portland.

I have thus given you my impartial opinion of the great utility of a breakwater for Portland Roads; it is a subject which justly claims the attention of every well-wisher to his country, not only with a view to the prosperity of its maritime interests, but also as a source of most acceptable relief to numbers of poor persons who are at present in a state of starvation for want of honest employment. I hope the British government will at once view the matter in its proper light, and sanction the early adoption of the measure proposed.

I beg to apologize for the length to which the subject has led me to address you; and have only to add, that should the breakwater for Portland Roads be finally accomplished, the gratitude of every Englishmen will be due to your late father, yourself, and brothers, for having been so instrumental in its formation.

I am, dear Sir,

Yours truly,

JOSEPH BENNET.

Besides this letter, Mr. Harvey has submitted to our inspection a whole bundle of communications of similar import; some from persons of like experience with Capt. Bennet—Captains of the Navy, Masters of merchant-vessels, &c., and others from Noblemen and Gentlemen connected with Weymouth and its neighbourhood. Sir E. B. Sugden, the Solicitor-General, who is one of the Members for Weymouth, pronounces the plan to be both "a national one" and "practicable." E. Berkeley Portman, Esq., M. P., states it to be in his estimation of "great public importance;" and expresses a hope, in which we heartily join him, that Government will only give the plan that "consideration which it deserves."

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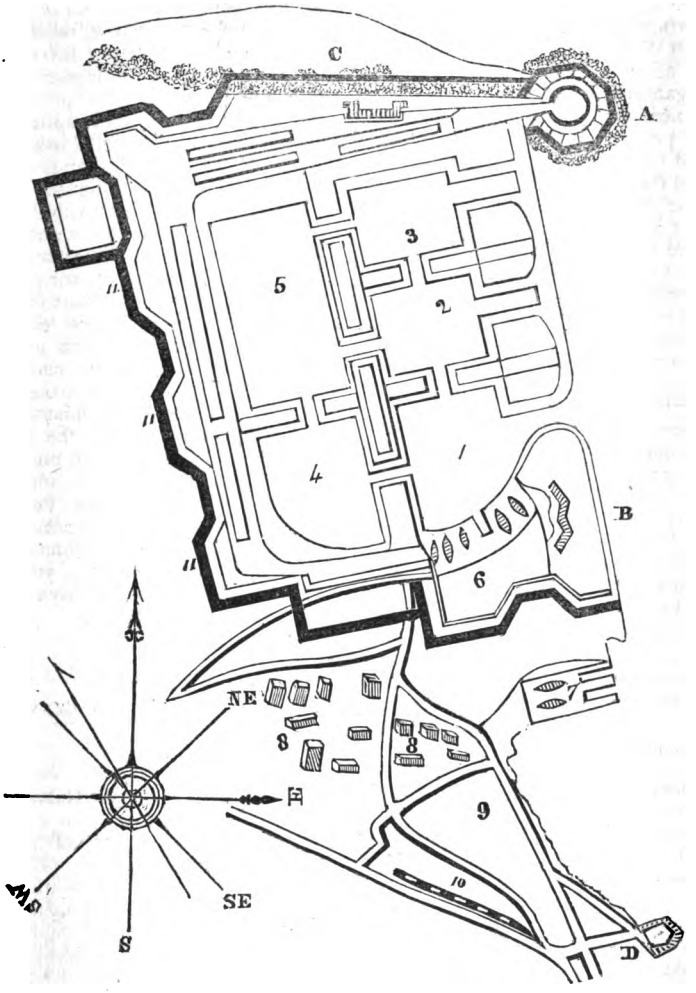
6. *Plan of the Dock-yards and Breakwater at Cherbourg.*



Explanation of the Letters of Reference.

Dock No. 1. 9 Acres.
2. 8 Do.
3. 8 Do.
4. 9 Do.
5. 16 Do.
6. Building-yard.
7. Do. Do.
8. Stonemason's-yard.
9. Timber-yards.
10. Store-houses.
11. A deep ditch and breast-work.
A. Fort d'Artois.
B. Fort Gallet.
C. Fort Homet.
D. Battery du Longlet.

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7. Brief Estimate of the Expense of a Breakwater at Portland. By Mr. John Harvey, Jun.

According to the nearest calculations I have been able to make, the total expense of the proposed breakwater would not exceed £600,000. The one at Plymouth is said to have already cost more than a million, and that at Cherbourg nearly two millions. Were a breakwater of such extent, as the one proposed, constructed in any other place in England, it could not be done for ten times £600,000; no other place affording the extraordinary advantage of an inexhaustible supply of stones, lying close at hand, and requiring only removal. In the £600,000, I include only the expense of raising the breakwater to high-water mark for the first quarter of a mile, and to low-water mark for the remaining two miles; and higher it would probably not be necessary to raise it. Should it, however, be required to raise the whole to high-water mark, there would be an additional charge of £75,240 per mile, or altogether £150,480.

J. H.

MEANS OF SECURING OF HOUSES FROM FIRE—REPORT OF THE ASSOCIATED ARCHITECTS, MESSRS. BONOMI, DANCE, SOANE, &c.

Sir,—I trust that your correspondent, Mr. Baddeley, will perceive by this *continuation* of the paper "on the securing of houses from fire," that I am no less anxious than he is for the total abolition of those dangerous and filthy partitions in buildings that are constructed of lath and plaster; and that no one could be more willing than I am to give every credit to that useful body of men, "the firemen of London." When I alluded to lath-and-plaster partitions in my last paper, it was prefatory to a general notice I shall shortly give, of the published report of the experiments conducted by the associated architects, and which are most conclusive as to the power of *plaster* properly applied. From the statements contained in the pamphlet (which is *now* before me), it appears that an association of architects in London was formed early in the year 1792; and among the members, the names of Bonomi, Dance, Carr, Jupp, Soane, Revett, &c. were conspicuous. The object of the formation of the society has been before explained; namely, to consider the "causes of the frequent fires within the limit of the act of the 14th Geo. III. ch. 73, for the further and better regulation of buildings and party-walls, &c. &c., and the best means that can be adopted for preventing the like in future." A committee of the whole body was formed, and they conducted their proceedings with a dispatch and success highly creditable to their zeal for the public good.

The committee (says the introduction) early saw, and resolved that as good party-walls are the means of confining a fire to one house, so other practicable, and not expensive, means might be devised which will confine a fire to one room in a house. And for the purpose of experiment, they procured two street houses, and had them finished ready for inhabiting, and secured according to their plans.

At that period professional men were well aware of the incongruities of the building-act which still remains in force, and if allowed to continue in operation, will effectually prevent any improvements in the construction of houses.

Iron had also been recommended as far back as 1785; for we find in a work, published as that time, entitled "Nutshells," the following excellent passage:—"Whenever the legislature shall think proper to enforce the general use of this excellent* contrivance in all future buildings, the present building-act may be repealed, and consigned to that oblivion it most justly merits." In any future act it would however be essential that the absurd custom of building upon brest-summer fronts of timber work should be universally restrained, and instead

* Securing by Lord Mahon's plan.

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thereof, wherever a similar mode of construction is necessary, the superincumbent wall should be erected upon iron cradles, bent into regular curves, which should be secured at their bases or springings by proper ties and abutments, and be supported by iron standards; the whole to be of wrought or even faggotted iron, but *by no means of cast-iron.*

Without attempting to favour the views of any particular set of tradesmen, I will add, that in very many cases brestsummers *may* be dispensed with altogether, whether of wood or of iron. A flat arch may by means of a tie-bar be made to support an enormous weight, as the tendency of spreading at the base is counteracted by the strength of the iron-rod, acted upon by tension; the rising at the haunches is prevented by the almost infinite load placed thereon. In the generality of cases, fires originate on the ground-floor; if in the upper apartments, the destruction is generally confined to the roof. The security of the basement and ground-stories should therefore claim our first attention.

To provide against absolute carelessness, or the malignant act of an incendiary, is beyond our power; and my firm conviction is, that nine-tenths of the fires in London originate from these causes.

For the security of buildings, I would again recommend the constant introduction of coombs or hollow pots (particularly described in a former paper); a partial use of them has lately taken place, although they were invented many years ago. The first instance of their application was at Knight's Hill, near Dulwich, the seat of Lord Thurlow.

In concluding, for the present, I may state, that in old houses the danger arising from fires was considerably increased by the girders projecting from the face of the ceiling, and being consequently exposed fully to the action of the fire. And although we cannot, till an alteration is made in the law, enforce a perfectly secure method of building, we ought, at least, to adopt such means of safety as are within our reach. Girders and brestsummers evidently can be secured; and at present their adoption rests with those parties who are improving their estates by covering them with houses.

I am, Sir,

Yours, &c.

CHRISTOPHER DAVY.

Furnival's Inn.

VINDICATION OF MR. DRURY'S IMPROVEMENTS IN BELLS—REPLY TO MR. HARRISON.

" Y'had best, quoth Ralpho, as the ancients
Say wisely, have a care o' th' main chance,
And look before you ere you leap;
For as you sow, y'are like to reap;
And were y'as good as George-a-Green,
I shall make bold to turn again;
Nor am I doubtful of the issue
In a just quarrel, and mine is so."

Sir,—It is a common remark that " two of a trade can never agree;" no wonder, then, that a person of Mr. Harrison's frame of mind, should take offence at Mr. Drury's improvements on bells.

As I had the pleasure of laying before your readers a description of these improvements in No. 331, of the " Mechanics' Magazine," I feel myself called upon to defend them from the illiberal aspersions attempted to be thrown upon them by Mr. Harrison at p. 163.

At the outset it is necessary I should state, that the sketch given at p. 282, of your last Volume, was made wholly from memory; and was intended to elucidate the *principle* of Mr. Drury's improvements, rather than to represent a practical application of them: had the latter been my object, I would have sent you a finished drawing upon a proper scale. I mention this circumstance, because in that sketch the several parts are not justly proportioned.

Mr. Harrison has not, however, referred to the original description, but has taken advantage of the still more roughly-made sketch of Mr. Hayter in No. 342, to draw the most erroneous and unwarrantable conclusions.

The first objection raised by Mr. Harrison, is—that the ringer has so

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much power over the hammer as to endanger the breaking of the bell. Perhaps Mr. Harrison will be sorry to learn, that by Mr. Drury's arrangements,* such an occurrence is not only very unlikely, but actually impossible!

Mr. Harrison's second objection, is —"that a variation in the power applied to the rope, although so small as to be almost imperceptible to the person exerting it, might cause a pretty smart blow." In this assertion, Mr. Harrison represents any variation in the power applied to the rope, as being *multiplied* in its effect upon the bell: the fact is, it is *diminished;* and that in proportion as the hammer-arm is longer than the radius of the wheel (W, vol. xii. p. 282). The size of the wheel, length of the hammer-arm, and space allotted for the hammer to pass through (for it may be limited to any portion of a semicircle), requires adjustment for bells of different sizes. As these details involve many extended and intricate calculations, and would occupy too much of your valuable room without proving of general interest to your readers, I shall not pursue this subject, beyond stating, that it includes the question of the *best material, weight,* and *velocity* for bell-hammers, briefly alluded to at the close of my communication at p. 283, vol. xii.

The principal objection of Mr. Harrison appears to be, that he considers it an evil to have "ringing made easy." Will the recreation of bell-ringing lose any of its charms by being made less laborious, and less dangerous? Certainly not.

There was, according to Brand, a very large bell at Canterbury, which required *thirty-two men* to ring it: now, with a hammer upon Drury's plan, a lad 14 years of age could produce the utmost sound this bell was capable of giving, and become an adept in the art and mystery of bell-ringing in a quarter of an hour. There is no fear of injuring the bell by striking it too hard; and a very little practice will determine the power necessary to be applied, to produce the *best effect.*

Mr. Harrison appears to possess an unfortunate propensity to

> "Obstruct, perplex, distract, entangle,
> And lay perpetual trains to wrangle;"

otherwise he would not attempt to throw dirt upon the merits of a successful rival, before he really understands in what his improvements consist.

Mr. Drury's improvements have long ceased to be a *new scheme,* as Mr. Harrison is pleased to designate them; having been successfully applied to practice some few years since: and they have the characters of *merit* and *originality* stamped upon them, beyond the power of Mr. Harrison to efface.

I have thus as briefly as possible furnished some materials for the refutation of Mr. Harrison's ill-natured remarks; a careful perusal of his communication will show, that in several instances he actually contradicts himself.

Should you, Mr. Editor, or any of your readers, feel sufficient interest in this matter to pay Mr. Drury a visit,* he will, I am sure, feel great pleasure in showing you a model of his improved mode of striking; as also, some very fine bells for a set of musical-chimes, now in hand, the powers of which are truly surprising. The inspection of these will exhibit in a more striking manner the value of Mr. Drury's improvements than I could do, were I to engross the whole of this and next week's Magazine.

I remain, Sir,

Yours respectfully,

WM. BADDELEY, Jun.

May 22, 1830.

* Of the minutiæ of which, Mr. Harrison as yet knows nothing, and therefore is not qualified to form an opinion.

* His address is, No. 15, Lower Islington Terrace, White Conduit Fields.

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A SONNET.—NO. III.

Man! thou art but a traveller on earth—
'Tis not thy home, altho' thy place of birth:
Are there not moments when thy daring mind
Feels shackled, bound, and narrowly confin'd?
Hast thou not vast, mysterious desires,
That upward tending, burn like flaming fires?
An ever-wandering, restless, busy thought,
With anxious hopes, and fears, and wishes fraught?
A craving, longing, mental appetite,
A hate of darkness, and a love for light?
What startles thee so much as that TO BE,
What has such charms, as immortality?
In life so far above the highest beast,
Shalt thou in Death sink lower than the least? T. M. B.

THE RAILWAY SYSTEM AND MR. GRAY —THE COMMERCIAL-ROAD TRAMWAY—HINT TO THE PROPRIETORS OF "THE NOVELTY."

(To the Editor of the Mechanics' Magazine.)

Friend,—I beg leave to offer a few remarks upon a subject which has of late frequently interested a considerable portion of the community—I mean the railway scheme, which I shall feel obliged by thy inserting in the "Mechanics' Magazine." In a letter, dated 5 mon. 1st, 1830, in the *Nottingham Review* of the 14th inst., written by Thomas Gray, author of a work on railways, I observe that he starts an objection to the system of working by friction—that if oily or greasy substances are applied to the rails or wheels that work upon them, the progress of the carriage will cease, the wheels revolving without proceeding in a forward direction. I think this plausible enough; and farther, that where inclined planes are used, if much traffic is upon them, the rails will become bright and smooth in dry weather, and prevent the adhesion to the wheels, which is necessary upon friction-rails. Now, as I am an admirer of the railway system, I feel glad to see them adopted upon any plan: but I still think the plan laid down by the author of "Observations on a General Iron Railway," the most efficient and best suited for a commercial country. The plan is an immense one, but I believe would ultimately pay the proprietors many fold, and prevent those intrusive competitions which must occur, if the best system is not at first adopted.

With respect to the tram-road laid down in the Commercial-road, will it not in a few years be worse than a common pavement? The different stones of which it is composed will wear irregularly, some being of softer material than others, even from the same quarry; and from the immense loads which are to be conveyed upon them, ruts and inequalities may be expected to present themselves soon, forming depots for rubbish, wet, &c. I am induced to think such will be the case, and that a rail-road of iron, formed for the situation, would have been found as cheap in the end, and more durable.

I am surprised at the care which appears to be taken by all authors on railways, not to mention the name of Thomas Gray, though some make rather free with his work. At all events, none can dispute his originality and undeviating perseverance in forwarding and bringing to public notice his favourite scheme. We may yet see the day when, like a Watt, his name will be handed about as one great pillar to our commercial structure.

While I am on the subject, let me recommend to the proprietors of "The Novelty" to attach a shaft with gear, to be thrown in and out at pleasure, with a cog-wheel on each side of the carriage to work on a railway with indentures or teeth, similar to that of Blenkinsop's; its superiority cannot be disputed, where immense loads are to be conveyed, especially on inclined planes, which will do away that annoyance which must oc-

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cur where fixed engines are used. No delay will be necessary, as the engineer can be prepared for the inclination before he arrives at it, and can immediately disengage the rack-work after it has performed its duty. "The Novelty" is now the favourite in point of speed and lightness, and would then be enabled to compete with any engine extant in the matter of drawing an immense load after it at the greatest speed.

W. BENNETT.

Nottingham, 1830, 5 *mo.* 18*th.*

REMARKS ON COOPER'S ROTARY FIRE-ENGINE.

Sir,—Professor Millington, in his "Epitome of Natural Philosophy," speaking of rotary-pumps, says, "the greatest difficulty in their construction is, that of keeping the sides of the flaps so packed as to maintain a perfect contact with the sides of the large cylinder without unnecessary friction; a fault which equally holds good in Mr. Bramah's fire-engines, in all eccentric-pumps, and in all the rotary steam-engines that have yet been invented."

If the account of Cooper's rotary fire-engine given in your 348th Number be correct, this great difficulty is at length surmounted: but, of this I have my doubts; and notwithstanding the opinion of the enlightened Professor Silliman, that "he does not think the proprietors of these engines have overrated their powers;" I feel no hesitation in saying that they have greatly overrated them.

A rough calculation from the data that are given,* will show that in each case the power said to have been applied, is really less than would be required to support a *quiescent* column of water of the altitudes mentioned; much less would it have been sufficient to throw a column of water to that height *in the form of a jet!*

That a *half-inch* jet of water has ever been thrown *one hundred and three feet high* by *eight men*, I deny. And, that a *one-inch* jet has ever been thrown *one hundred and three feet high* by *twenty men*, I also deny.

To be sure, if an English writer of the last century is to be believed, the common piston fire-engines are now much inferior to what they were when first invented. Stephen Switzer, in his "Universal System of Water and Waterworks," published in 1734, speaking of Newsham's fire-engine, then just brought out, says, "*Great attempts* have been made to *exceed*, but *none* yet could *equal this* sort; the fifth size* of which hath played *above* the grasshopper upon the Royal Exchange, which is upwards of 55 yards (*one hundred and sixty-five feet*) high!! and this in the *presence of many thousand spectators.*"

From repeated observations, I am induced to believe that it is impossible, even were the power infinite, to impel a jet of water half an inch in diameter through the resisting medium of the atmosphere, with a sufficient velocity to give it any thing like the elevation said to have been attained in the experiment with Cooper's fire-engine.

Fire-engines of the usual constructions, worked by twelve or fourteen men, throw jets of water, from one-half to five-eighths of an inch diameter, to an elevation of from 60 to 70 feet: and they must be in very good order to do this. The floating fire-engine (see vol. xii. p. 455), worked by *fifty men*, and the steam fire-engine of Mr. Braithwaite of *six-horse* power, with one-inch jets, each attain an altitude of from 80 to 90 feet.

The printed prospectus of the American Hydraulic Company consists almost wholly of what we here call *twaddle;* in one portion of it they say, "the fact is self-evident, that in working the old engines, to discharge the chamber or cylinder *once*, the piston must pass *twice* through it." This is only partly true; the objection will not apply to Rangeley's, Eve's, Rountree's, Bramah's, Barton's, or Ruthven's fire-engines; nor, in fact, to any

* One very important datum—the number of revolutions made per minute—is *not* given. The *thermometric* observation, is an affected nicety which ill accords with the general detail of the experiments.

* Newsham made six sizes, this was the largest but one, and was said to deliver 160 gallons of water per minute.

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of the other *rotary* or *vibratory* engines; nor to those on De la Hire's principle, which principle Mr. Braithwaite has judiciously adopted in his steam fire-engine.

I must here remark, that I am surprised to see De la Hire's form of pump so much neglected; the advantages which it offers are so great and important, that I can only account for such neglect, by supposing that it is not so generally known as its merits deserve: the insertion of the enclosed description in an early Number of your widely-circulated Magazine,* will tend in a very great measure to remedy this circumstance.

In conclusion, I shall anxiously expect the promised description of the mechanism of Cooper's rotary fire-engine, that your numerous readers may be enabled to judge with myself, how far it is entitled to be considered the *ne plus ultra* of hydraulic machinery.

I am, Sir,
Respectfully yours,
WM. BADDELEY, Jun.

NEW BUILDING-ACT.

Sir,—As it is with the law of patents, so I fear it is with the new building-act: another session will pass over without any thing being done; and, perhaps, another and another. In the meantime thousands of houses, on the matchwood principle, will be added to the disgraceful erections, which place in jeopardy the lives and limbs of so many human beings. One of the reasons assigned for so few fires occurring in Paris and other continental cities is, that they have no insurance offices. That our insurance companies are very great gainers by every fire which occurs, there, perhaps, need be no doubt: yet we must not suppose that they are ever directly concerned in setting fire to dwelling houses; but that the builders, who know they can insure, are regardless how they construct our habitations.

I think it is certain if they could not insure they would build differently. And if a new building-act were not now before Parliament, I would have inquired whether it is not possible to induce persons to build on fire-proof principles? Could not a society be formed, and encouragement be given to those who will undertake to make houses for safety from fire, by employing them, or renting or purchasing the dwellings they may thus construct? If no encouragement can be found in that way, nothing, perhaps, but an Act of Parliament will lessen the evil.

I am, Sir,
Yours, &c.
C. D. S.

* It shall have an early place.—ED.

CONCISE LOGARITHMIC TABLES OF NUMBERS, SINES, AND TANGENTS.

BY J. W. WOOLLGAR, ESQ.

Sir,—Notwithstanding the variety of logarithmic tables extant, from the bulky folio of Vega to the single sheet in 18mo. of Carr, I am yet encouraged by the remarks of your valued correspondent, P. M. W. (vol. xii. p. 86), to present to the public a new set, in which the principle of condensation is, I believe, carried farther than has ever been done before. They consist of logarithms of numbers, and of sines and tangents, each to 5 decimal places, and each comprised in 4 pages. In their construction I have availed myself of the expedients used by Hutton, Callet, Borda, Galbraith, &c. It is not to be supposed that such tables will answer every purpose to which the larger ones can be applied; but that tables limited to 5 places have very considerable utility, is evident from the frequency of their occurrence.

Tables of the logarithms of numbers to 5 places, generally contain an uniform progression from 1000 to 10,000, being 9000 values; and it is assumed, that between each of these, 9 other values may be interpolated. In the present set, the number of values is only 1380, but so selected, and furnished with auxiliary columns, that the rest, not merely of the 9000,

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but of the 90,000, may be supplied by mental operations only; and that to as great a degree of accuracy* in almost all cases, as can be attained by the common tables. The time, also, occupied by the addition of the proportional parts, cannot, after a little practice, be greater than is consumed in turning over the leaves of larger tables.†

Arrangement and Use.

The series of numbers from 100,0 to 1000 is divided into 2 portions; the first occupying nearly 2 pages, and extending from 100,0 to 220,0; in which the 3 first figures of a given number are to be found in the left-hand column, and the 4th (even) figure at the head of the first 5 columns of the page. The succeeding columns, headed 1 to 19, contain the proportional parts. Of these, a distinct set is at first given for each line, then 1 for every 2 lines, and afterwards 1 for every 5. The second portion extends from 220,0 to 1000,0, commencing at the right-hand side of the second page; and in this the numbers are contained in single columns, divided into decades, every one of which has 10 logarithms on its right, and a table of proportional parts on its left. By inserting only the unit figures of the numbers after the first in each decade, those figures serve as arguments for the proportional parts standing close to them. In general, each set of proportional parts is to be used for the decade to which it is attached: but between 220 and 340 the sets are more numerous; and that set is to be used which has at the head of it a number, (enclosed in a parenthesis,) nearest in amount to the 3 first figures of the number whose logarithm is to be found.

The table gives only the decimal part of a logarithm: the index is *less* by unity than the quota of figures in the integral part of the given number. If there be but one integral figure, the index is 0·; and if the number be less than unity, the index is negative, and is *greater* by unity than the quota of cyphers immediately following the decimal point.

Examples. To find the logarithms of 1032, 1033, 103·37, 17·475, 2408·6, 52100, 6·8192, and 0·89074.

1032 — log.	3·01368	1032 log.	3·01368	17·46 log.	1·24204	6·81 log.	0·83315
		1,0 —	42	·015 —	37	009 —	57,1
						0002 —	1,27
0·890 .. —	1·94939	1033 —	3·01410	17·475 —	1·24241		
0007	34,0					6·8192	0·83373
00004	1,94	103·2 —	2·01368	2400 —	3·38021		
		·17 —	71	8 —	144		
0·89074 —	1·94975			0·6 —	10,8	52100 log.	4·71684
		103·37 —	2·01439				
				2408·6 —	3·38176		

To find the numbers answering to the logarithms, 3·98268, 3·21018, 1·15261, 0·66667.

Log. given	3·98268	Log. given	3·21018	L g. given	1·15261	Log. given	0·66667
next less 9600	3·98227	next less 1622	3·21005	next less 14·20	1·15229	next less 4·64	0 66652
add p. p. 9·0	41	add p. p. 0·5	13	add p. p. 011	32	add p. p. 0016	15
							1....9
9609·0		1622·5		14·211		4·6416	—
							66....6

* The tables will readily give, within 1 unit in the last place, the logarithm to 5 places, of any number not exceeding 5 significant figures. No tables extant can give the logarithms of such numbers true to the *nearest* unit in the 5th place, except such as extend to 6 or more decimals. Mr. Babbage, by placing dots over certain terminal figures, has increased the *probability* of obtaining the last figure with truth; but this plan does not render such result *certain*, and, moreover, could not be executed without having types cast on purpose.

† Many tables are without differences or proportional parts, or both. The want of them is by no means compensated by increasing the number of values. The present table is constructed upon the plan of extending the auxiliary apparatus as much as possible.

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The arithmetical complement of a logarithm is found by taking each figure from 9, except the right-hand effective figure, which is to be deducted from 10. If the index be negative, the complemental index is positive, and less by unity.

In logarithmic arithmetic, multiplication is effected by addition, division by subtraction, involution by multiplication, and evolution by division.

Examples. To multiply 123·35 by 77·9; to divide 6·7643 by 0·476; to find the square of 40·28; and to extract the cube root of 100.

123·35	log. 2·09114	6·7643	log. 0·83022	40·28	log. 1·60509	100	log. 2·00000
77·9	— 1·89154	0·476	—1·67761	Index of power	2	Index 3	÷
9609·0	— 3·98268	14·2107	1·15261	1622·5	— 3·21018	4·6416	0·66667

The tables of sines and tangents form the second division of the present set, and are adequate to almost all trigonometrical calculations, where greater exactness in the result than $\frac{1}{10}$ of a minute is not required. The largeness of the differences in the logarithmic form rendered it necessary to give a much greater number of values than in the table of *natural* sines, &c., the uses of which P. M. W. has so copiously illustrated. The tangents are only given for the first half of the quadrant, but those for the other half, as also the secants, are readily obtained; thus,

Tan. (45° to 90°)=20—cotangent. Secant=20—cosine.
Cot. (0 to 45)=20—tangent. Cosecant=20—sine.

The intervals between the successive values are regulated by the extent of the differences; thus,

From 0° to 4° the intervals are 2′ 10° to 15° the intervals are 5′
4° to 10° . . . . . 3′ 15° to 45° . . . . . 10′

and inversely through the remainder of the quadrant. Excepting in the first page, the differences are given for 10′ (or for 1′ by cutting off the right-hand figure): but in the first 4 degrees the second differences are so great, that an interpolation by first differences only would be inaccurate; a defect to which even larger tables are subject. In lieu, therefore, of the ordinary differences, two columns are given, expressing the logarithm of the quotient of each sine and tangent, divided by its arc expressed in minutes; and these are quantities whose differences are small. The method of using them will be presently shown.

Examples. Required the sine and cosine of 12° 26′; the tangent and cotangent of 30° 53′·3; the secant and cosecant of 54° 20′.

Sine	12° 25′	9·33248	Tan.	30° 50′	9·77591	Cosin.	54° 20′	9·76572
Pro. pa.	1′	57,2	P. p.	3·3 × 28·7	94,71	Secant		10·23428
Sine	12 26	9·33305	Tan.	30 53·3	9·77686	Sine	54 20	9·90978
Cosin.	12 30	9·98958	Cotan.		10·22314	Cosecant		10·09022
Pro. pa.	4 × 2·8	11·2						
Cosin.	12 26	9·98969						

Required the angles answering to log. sin. 9·78032, log. cos. 9·89969, log. cot. 10·58061, log. sec. 10·71482.

Sine given		9·78032	Cos. given		9·89969	Cot. given		10·58061	Sec. given		10·71482
Sine	37° 0′	9·77946	Cos.	37° 20′*	9·90043						
		16·7)86			9·7)74	Tan.		9·41939	Cosine		9·28518
						Tan.	14° 40′	9·41784	Cos.	78° 50′	9·28705
								51·4)155			64·2)187
Ans.	37 5·15	5·15	Ans.	37 27·6	7·6	Ans.	14 43	3	Ans.	78 52·9	2·9

* When cosines, &c. are given, the tabular values taken out must be the next greater.

If the given angle be under 4°, and be not found by inspection, take out of the table the nearest quantity (in the column ρ sin.) and add to it the logarithm of the angle reduced to minutes, the sum will be the log. sine re-

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quired. Conversely, if the sine be given, subtract the auxiliary log. which is on the same line with the nearest tabular sine, the remainder will be the log. of the number of minutes contained in the angle sought. A similar rule applies to the tangents.

Examples. Required the log. sine of 2° 14′ 36″. Required the angle whose log. tang. is 8·19842.

2° 14′ 36″=134′·6, log.	2·12905	Given log. tan.	8·19842
Tabular ρ sin.	6·46362	Tab. ρ tan. to 0° 54′	6·46377
Sin. 2° 14′·6	8·59267	Log. 54′·28=0° 54′ 17″	1·73465

Plane Trigonometry.

On the application of the tables to the purposes of plane trigonometry, the instructions of P. M. W. would leave me nothing to say, were it not that the formulæ selected by him for the second and third cases of oblique triangles, are not the best adapted to a logarithmic process.

At present, however, I shall confine myself to a set of equations suitable for solving logarithmically all the cases of right and oblique-angled triangles.

Let the letter λ prefixed to a quantity denote its logarithm, and κ the arithmetical complement of its log. Also let AB, AC, BC, be the sides of a triangle, of which C, B, A, are the angles respectively opposite. Also let $S=\frac{1}{2}(AB+AC+BC)$.

1. *Right-angled Triangles.*

Wherein BC is the hypothenuse, and AB may be either the base or the perpendicular, so that B stand for its adjacent, and C for its opposite angle.

$$\lambda AB=\tfrac{1}{2}[\lambda(BC+AC)+\lambda(BC-AC)] \quad (1)$$
$$=\lambda\cos B+\lambda BC \quad (2)$$
$$=\lambda\sin C+\lambda BC \quad (3)$$
$$=\lambda\cot B+\lambda AC \quad (4)$$
$$=\lambda\tan C+\lambda AC \quad (5)$$
$$\lambda BC=\tfrac{1}{2}[\lambda(Z+AC)+\lambda AC];\ \text{where } Z=2\lambda AB-\lambda AC \quad (6)$$
$$=\kappa\cos B+\lambda AB \quad (7)$$
$$=\kappa\sin C+\lambda AB \quad (8)$$
$$\lambda\sin B=\kappa BC+\lambda AC \quad (9)$$
$$\lambda\cos B=\kappa BC+\lambda AB \quad (10)$$
$$\lambda\tan B=\kappa AB+\lambda AC \quad (11)$$
$$\lambda\cot B=\kappa AC+\lambda AB \quad (12)$$
$$\lambda\tan\tfrac{1}{2}B=\tfrac{1}{2}[\kappa(BC+AB)+\lambda(BC-AB)] \quad (13)$$

The last formula to be used when $\angle B$ is very small.

2. *Oblique-angled Triangles.*

Wherein BC may represent any side whatever, so that A stand for its opposite, and B, C, its adjacent angles.

$$\lambda\sin A=\kappa AB+\lambda BC+\lambda\sin C \quad (14)$$
$$\lambda BC=\kappa\sin C+\lambda\sin A+\lambda AB \quad (15)$$
$$\lambda\tan\tfrac{1}{2}(B\sim C)=\kappa(AC+AB)+\lambda(AC\sim AB)+\lambda\tan\tfrac{1}{2}(180-A) \quad (16)$$
$$\lambda BC=\kappa\cos\tfrac{1}{2}(B\sim C)+\lambda\cos\tfrac{1}{2}(180-A)+\lambda(AC+AB) \quad (17)$$

Should $\frac{1}{2}(B\sim C)$ be near 90°, and the values of B and C not required, substitute in the last equation, $\lambda\tan\frac{1}{2}(B\sim C)+\kappa\sin\frac{1}{2}(B\sim C)$, for $\kappa\cos\frac{1}{2}(B\sim C)$.

$$\lambda\sin\tfrac{1}{2}A=\tfrac{1}{2}[\kappa AB+\kappa AC+\lambda(S-AB)+\lambda(S-AC)] \quad (18)$$
$$\lambda\tan\tfrac{1}{2}A=\tfrac{1}{2}[\kappa S+\kappa(S-BC)+\lambda(S-AB)+\lambda(S-AC)] \quad (19)$$

The former of the two last formulæ should not be used when $\frac{1}{2}A$ is near 90°.

J. W. WOOLLGAR.

Lewes, 10th *Oct.* 1829.

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1	432	518	604	689	775	4 9 13 17	21 26 30 34	39 43 47 51	56 60 64 68	73 77 81
2	860	945	01030	01115	01199	4 8 13 17	21 25 30 34	38 42 47 51	55 59 64 68	72 76 81
3	01284	01368	452	536	620	4 8 13 17	21 25 29 34	38 42 46 50	55 59 63 67	71 76 80
4	703	787	870	953	02036	4 8 12 17	21 25 29 33	37 42 46 50	54 58 62 67	71 75 79
5	02119	02202	02284	02366	449	4 8 12 16	21 25 29 33	37 41 45 49	54 58 62 66	70 74 78
6	531	612	694	776	857	4 8 12 16	20 24 29 33	37 41 45 49	53 57 61 65	69 73 78
7	938	03019	03100	03181	03262	4 8 12 16	20 24 28 32	36 40 44 48	53 57 61 65	69 73 77
8	03342	423	503	583	663	4 8 12 16	20 24 28 32	36 40 44 48	52 56 60 64	68 72 76
9	743	822	902	981	04060	4 8 12 16	20 24 28 32	36 40 44 48	52 56 60 64	67 71 75
110	04139	04218	04297	04376	454	4 8 12 16	20 24 28 31	35 39 43 47	51 55 59 63	67 71 75
1	532	610	689	766	844	4 8 12 16	20 23 27 31	35 39 43 47	51 55 59 62	66 70 74
2	922	999	05077	05154	05231	4 8 12 15	19 23 27 31	34 39 42 46	50 54 58 62	66 69 73
3	05308	05385	461	538	614	4 8 11 15	19 23 27 31	34 38 42 46	50 54 57 61	65 69 73
4	690	767	843	918	994	4 8 11 15	19 23 26 30	34 38 42 45	49 53 57 61	64 68 72
5	06070	06145	06221	06296	06371	4 8 11 15	19 23 26 30	34 38 41 45	49 53 56 60	64 68 71
6	446	521	595	670	744	4 7 11 15	19 22 26 30	33 37 41 45	48 52 56 60	63 67 71
7	819	893	967	07041	07115	4 7 11 15	19 22 26 30	33 37 41 44	48 52 55 59	63 67 70
8	07188	07262	07335	408	482	4 7 11 15	18 22 26 29	33 37 40 44	48 51 55 59	62 66 70
9	555	628	700	773	846	4 7 11 15	18 22 25 29	33 36 40 44	47 51 54 58	62 65 69
120	918	990	08063	08135	08207	4 7 11 14	18 22 25 29	32 36 40 43	47 50 54 58	61 65 68
1	08279	08350	422	493	565	4 7 11 14	18 21 25 29	32 36 39 43	46 50 54 57	61 64 68
2	636	707	778	849	920	4 7 11 14	18 21 25 28	32 36 39 43	46 50 53 57	60 64 67
3	991	09061	09132	09202	09272	4 7 11 14	18 21 25 28	32 35 39 42	46 49 53 56	60 63 67
4	09342	412	482	552	621	3 7 10 14	17 21 24 28	31 35 38 42	45 49 52 56	59 63 66
5	691	760	830	899	968	3 7 10 14	17 21 24 28	31 35 38 42	45 48 52 55	59 62 66
6	10037	10106	10175	10243	10312	3 7 10 14	17 21 24 27	31 34 38 41	45 48 51 55	58 62 65
7	380	449	517	585	653	3 7 10 14	17 20 24 27	31 34 38 41	44 48 51 55	58 61 65
8	721	789	857	924	992	3 7 10 14	17 20 24 27	30 34 37 41	44 47 51 54	57 61 64
9	11059	11126	11193	11261	11327	3 7 10 13	17 20 23 27	30 34 37 40	44 47 50 54	57 60 64
130	394	461	528	594	661	3 7 10 13	17 20 23 26	30 33 36 40	43 46 50 53	56 60 63
1	727	793	860	926	992					
2	12057	12123	12189	12254	12320	3 7 10 13	16 20 23 26	29 33 36 39	43 46 49 52	56 59 62
3	385	450	516	581	646					
4	710	775	840	905	969	3 6 10 13	16 19 23 26	29 32 35 39	42 45 48 52	55 58 61
5	13033	13098	13162	13226	13290					
6	354	418	481	545	609	3 6 10 13	16 19 22 25	29 32 35 38	41 44 48 51	54 57 60
7	672	735	799	862	925					
8	988	14051	14114	14176	14239	3 6 9 12	16 19 22 25	28 31 34 37	41 44 47 50	53 56 59
9	14301	364	426	489	551					
140	613	675	737	799	860	3 6 9 12	15 18 22 25	28 31 34 37	40 43 46 49	52 55 59
1	922	983	15045	15106	15168					
2	15229	15290	351	412	473	3 6 9 12	15 18 21 24	27 30 33 36	40 43 46 49	52 55 58
3	534	594	655	715	776					
4	836	897	957	16017	16077	3 6 9 12	15 18 21 24	27 30 33 36	39 42 45 48	51 54 57
5	16137	16197	16256	316	376					
6	435	495	554	613	673	3 6 9 12	15 18 21 24	27 30 33 36	38 41 44 47	50 53 56
7	732	791	850	909	967					
8	17026	17085	17143	17202	17260	3 6 9 12	15 18 20 23	26 29 32 35	38 41 44 47	50 53 55
9	319	377	435	493	551					
150	609	667	725	782	840	3 6 9 12	14 17 20 23	26 29 32 35	37 40 43 46	49 52 55
1	898	955	18013	18070	18127					
2	18184	18241	298	355	412	3 6 9 11	14 17 20 23	26 28 31 34	37 40 43 45	48 51 54
3	469	526	583	639	696					
4	752	808	865	921	977	3 6 8 11	14 17 20 22	25 28 31 34	36 39 42 45	48 50 53
5	19033	19089	19145	19201	19257					
6	312	368	424	479	535	3 6 8 11	14 17 19 22	25 28 30 33	36 39 42 44	47 50 53
7	590	645	700	756	811					
8	866	921	976	20030	20085	3 5 8 11	14 16 19 22	25 27 30 33	35 38 41 44	64 49 52
9	20140	20194	20249	303	358					
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N.	0	2	4	6	8	1	3	5	7	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
160	20412	20466	20520	20575	20629		3	5	8	11			14	16	19				22	24	27							
1	683	737	790	844	898		30	32	35	38			41	43	46	49	51											
2	952	21005	21059	21112	21165		3	5	8	11			13	16	19				21	24	27							
3	21219	272	325	378	431		29	32	35	37			40	43	45				48	51								
4	484	537	590	643	696		3	5	8	11			13	16	18				21	24	26							
5	748	801	854	906	958		29	32	34	37			39	42	45				47	50								
6	22011	22063	22115	22167	22220		3	5	8	10			13	16	18				21	23	26							
7	272	324	376	427	479		29	31	34	36			39	42	44				47	49								
8	531	583	634	686	737		3	5	8	10			13	15	18				21	23	26							
9	789	840	891	943	994		28	31	33	36			39	41	44				46	49								
170	23045	23096	23147	23198	23249		3	5	8	10			13	15	18				20	23	25							
1	300	350	401	452	502		28	30	33	35			38	41	43				46	48								
2	553	603	654	704	754		3	5	8	10			13	15	18				20	23	25							
3	805	855	905	955	24005		28	30	33	35			38	40	43				45	48								
4	24055	24105	24155	24204	254		2	5	7	10			12	15	17				20	22	25							
5	304	353	403	452	502		27	30	32	35			37	40	42				45	47								
6	551	601	650	699	748		2	5	7	10			12	15	17				20	22	25							
7	797	846	895	944	993		27	29	32	34			37	39	42				44	47								
8	25042	25091	25139	25188	25237		2	5	7	10			12	15	17				19	22	24							
9	285	334	382	431	479		27	29	32	34			36	39	41				44	46								
180	527	575	624	672	720																							
1	768	816	864	912	959		2	5	7	10			12	14	17				19	21	24							
2	26007	26055	26102	26150	26198		26	29	31	33			36	38	40				43	45								
3	245	293	340	387	435																							
4	482	529	576	623	670																							
5	717	764	811	858	905																							
6	951	998	27045	27091	27138		2	5	7	9			12	14	16				19	21	23							
7	27184	27231	277	323	370		26	28	30	32			35	37	39				42	44								
8	416	462	508	554	600																							
9	646	692	738	784	830																							
190	875	921	967	28012	28058																							
1	28103	28149	28194	240	285		2	5	7	9			11	14	16				18	20	23							
2	330	375	421	466	511		25	27	29	32			34	36	38				41	43								
3	556	601	646	691	735																							
4	780	825	870	914	959																							
5	29003	29048	29092	29137	29181																							
6	226	270	314	358	403		2	4	7	9			11	13	15				18	20	22							
7	447	491	535	579	623		24	26	29	31			33	35	37				40	42								
8	667	710	754	798	842																							
9	885	929	973	30016	30060																							
200	30103	30146	30190	233	276																							
1	320	363	406	449	492		2	4	6	9			11	13	15				17	19	21							
2	535	578	621	664	707		24	26	28	30			32	34	37				39	41								
3	750	792	835	878	920																							
4	963	31006	31048	31091	31133																							
5	31175	218	260	302	345																							
6	387	429	471	513	555		2	4	6	8			10	13	15				17	19	21							
7	597	639	681	723	765		23	25	27	29			31	33	36				38	40								
8	806	848	890	931	973																							
9	32015	32056	32098	32139	32181																							
210	222	263	305	346	387																							
1	428	469	510	552	593		2	4	6	8			10	12	14				16	18	20							
2	634	675	715	756	797		22	24	27	29			31	33	35				37	39								
3	838	879	919	960	33001																							
4	33041	33082	33122	33163	203																							
5	244	284	325	365	405																							
6	445	486	526	566	606		2	4	6	8			10	12	14				16	18	20							
7	646	686	726	766	806		22	24	26	28			30	32	34				36	38								
8	846	885	925	965	34005																							
9	34044	34084	34124	34163	203																							

Pro parts.			N.	Log.
(220)	(223)	(226)	220	34249
20	19	19	1	430
39	39	38	2	635
59	58	58	3	839
79	78	77	4	35025
98	97	96	5	218
118	117	115	6	411
138	136	134	7	603
158	155	153	8	798
177	175	173	9	984
(229)	(232)	(235)	230	36173
19	19	18	1	361
38	37	37	2	549
57	56	55	3	736
76	75	74	4	923
95	93	92	5	37107
114	112	111	6	291
133	131	129	7	476
151	149	148	8	658
170	168	166	9	840
(238)	(241)	(244)	240	38021
18	18	18	1	202
36	36	36	2	382
55	54	53	3	561
73	72	71	4	739
91	90	89	5	917
109	108	107	6	39094
127	126	124	7	270
146	144	142	8	446
164	162	160	9	620
(248)	(252)	(256)	250	794
17	17	17	1	967
35	34	34	2	40140
52	52	51	3	312
70	69	68	4	483
87	86	85	5	654
105	103	102	6	834
122	120	119	7	993
140	138	135	8	41162
157	155	152	9	330
(260)	(264)	(268)	260	497
17	16	16	1	664
33	33	32	2	830
50	49	49	3	996
67	66	65	4	42160
83	82	81	5	325
100	99	97	6	488
117	115	113	7	651
133	131	129	8	813
150	148	146	9	975
(272)	(276)	(280)	270	43136
16	16	16	1	297
32	31	31	2	457
48	47	47	3	616
64	63	62	4	775
80	79	78	5	933
96	94	93	6	44091
112	110	108	7	248
128	126	124	8	404
143	141	139	9	560

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Pro. par.	N.	Log.	p.p.	N	Log.	p p.	N	Log.	p.p.	N	Log.	p p.	N	Log.	p p.	N	Log.
(282)(287)	280	44716		340	53148		400	60206		460	66276		520	71600		580	76343
15 15	1	871	13	1	275	11	1	314	9	1	370	8	1	684	7	1	418
31 30	2	45025	25	2	403	21	2	423	19	2	464	17	2	767	15	2	492
46 45	3	179	38	3	529	32	3	531	28	3	66558	25	3	850	22	3	76567
62 60	4	332	50	4	656	43	4	638	37	4	652	33	4	933	30	4	641
77 75	5	484	63	4	782	53	5	746	47	5	745	41	5	72016	37	5	716
93 91	6	637	76	6	908	64	6	853	56	6	839	50	6	099	44	6	790
108 106	7	788	88	7	54033	75	7	959	65	7	932	58	7	181	52	7	864
123 121	8	939	101	8	158	86	8	61066	75	8	67025	66	8	263	59	8	938
138 136	9	46090	113	9	283	96	9	172	84	9	117	75	9	346	67	9	77012
292)(297)	290	240		350	407		410	278		470	210		530	428		590	085
15 15	1	389	12	1	531	10	1	384	9	1	302	8	1	72509	7	1	159
30 29	2	538	24	2	654	21	2	490	18	2	394	16	2	591	15	2	232
45 44	3	687	37	3	777	31	3	595	27	3	486	24	3	673	22	3	305
59 58	4	835	49	4	900	42	4	700	37	4	67578	32	4	754	29	4	379
74 73	5	982	61	5	55023	52	5	805	46	5	669	40	5	835	36	5	452
89 88	6	47129	73	6	145	63	6	909	55	6	761	49	6	916	44	6	77525
104 102	7	276	85	7	267	73	7	62014	64	7	852	57	7	997	51	7	597
118 117	8	422	98	8	388	84	8	118	73	8	943	65	8	73078	58	8	670
134 131	9	567	110	9	509	94	9	221	82	9	68034	73	9	159	66	9	743
(302)(307)	300	712		360	630		420	325		480	124		540	239		600	815
14 14	1	857	12	1	751	10	1	428	9	1	215	8	1	320	7	1	887
29 28	2	48001	24	2	871	20	2	531	18	2	305	16	2	400	14	2	960
43 42	3	144	36	3	991	31	3	634	27	3	395	24	3	480	22	3	78032
58 57	4	287	48	4	56110	41	4	737	36	4	485	32	4	73560	29	4	104
72 71	5	430	59	5	229	51	5	839	45	5	68574	40	5	640	36	5	176
86 85	6	572	71	6	348	61	6	941	54	6	664	48	6	719	43	6	247
101 99	7	714	83	7	467	71	7	63043	63	7	753	56	7	799	50	7	319
115 113	8	855	95	8	585	82	8	144	72	8	842	64	8	878	58	8	390
130 127	9	996	107	9	703	92	9	246	81	9	931	72	9	957	65	9	462
(312)(317)	310	49136		370	820		430	347		490	69020		550	74036		610	78533
14 14	1	276	12	1	937	10	1	448	9	1	108	8	1	115	7	1	604
28 27	2	415	23	2	57054	20	2	548	18	2	197	16	2	194	14	2	675
42 41	3	554	35	3	171	30	3	649	26	3	285	23	3	273	21	3	746
56 55	4	693	46	4	287	40	4	749	35	4	373	31	4	351	28	4	817
69 68	5	831	58	5	403	50	5	849	44	5	461	39	5	429	35	5	888
83 82	6	969	70	6	519	60	6	949	53	6	69548	47	6	74507	42	6	958
97 96	7	50106	81	7	634	70	7	64048	62	7	636	55	7	586	49	7	79029
111 109	8	243	93	8	749	80	8	147	70	8	723	62	8	663	57	8	099
125 123	9	379	104	9	864	90	9	246	79	9	810	70	9	741	64	9	169
(322)(327)	320	515		380	978		440	345		500	897		560	819		620	239
13 13	1	651	11	1	58092	10	1	444	9	1	984	8	1	896	7	1	309
27 27	2	786	23	2	206	20	2	542	17	2	70070	15	2	74	14	2	379
40 40	3	920	34	3	320	29	3	640	26	3	157	23	3	70051	21	3	449
54 53	4	51055	45	4	433	39	4	738	34	4	243	31	4	128	28	4	79518
67 66	5	188	56	5	546	49	5	836	43	5	329	38	5	205	35	5	588
81 80	6	322	68	6	659	59	6	933	52	6	415	46	6	282	42	6	657
94 93	7	455	79	7	771	69	7	65031	60	7	70501	54	7	358	49	7	727
108 106	8	587	90	8	883	78	8	128	69	8	586	62	8	435	56	8	796
121 119	9	720	102	9	995	88	9	225	77	9	672	69	9	75511	63	9	865
(332)(337)	3 0	851		390	59106		450	321		510	757		570	587		630	934
13 13	1	983	11	1	218	10	1	418	8	1	842	8	1	664	7	1	80003
26 26	2	52114	22	2	329	19	2	514	17	2	927	15	2	740	14	2	072
39 39	3	244	33	3	439	29	3	610	25	3	71012	23	3	815	21	3	140
52 51	4	375	44	4	550	38	4	706	34	4	096	30	4	891	27	4	209
65 64	5	504	55	5	660	48	5	801	42	5	181	38	5	967	34	5	277
78 77	6	634	66	6	770	57	6	896	51	6	265	45	6	76042	41	6	346
91 90	7	763	77	7	879	67	7	992	59	7	349	53	7	118	48	7	414
104 103	8	892	88	8	988	76	8	66087	67	8	433	60	8	193	55	8	482
118 116	9	53020	99	9	60097	86	9	181	76	9	71517	68	9	268	62	9	80550

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p.p.	N.	Log.	p.p.	N.	Log.	p.p.	N.	Log.	p.p.	N.	Log.	p.p.	N.	Log.	p.p.	N.	Log.
	640	80618		700	84510		760	88081		820	91381		880	94448		940	97313
·7	1	686	6·2	1	572	5·7	1	138	5·3	1	434	4·9	1	498	4·6	1	359
13·5	2	754	12·3	2	634	11·4	2	195	10·5	2	487	9·8	2	94547	9·2	2	405
20·2	3	821	18·5	3	696	17·0	3	252	15·8	3	91540	14·7	3	596	13·8	3	451
27·0	4	889	24·7	4	757	22·7	4	309	21·1	4	593	19·6	4	645	18·4	4	497
33·7	5	956	30·8	5	819	28·4	5	366	26·3	5	645	24·5	5	694	23·0	5	97543
40·4	6	81023	37·0	6	880	34·1	6	423	31·6	6	698	29·5	6	743	27·6	6	589
47·2	7	090	43·2	7	942	39·8	7	480	36·9	7	751	34·4	7	792	32·2	7	635
53·9	8	158	49·4	8	85003	45·4	8	88530	42·2	8	803	39·3	8	841	36·8	8	681
60·7	9	224	55·5	9	065	51·1	9	593	47·4	9	855	44·2	9	890	41·4	9	727
	650	291		710	126		770	649		830	908		890	939		950	772
6·6	1	358	6·1	1	187	5·6	1	705	5·2	1	960	4·9	1	988	4·5	1	818
13·3	2	425	12·2	2	248	11·2	2	762	10·4	2	92012	9·7	2	95036	9 1	2	864
19·9	3	491	18·2	3	309	16·8	3	818	15·6	3	065	14·6	3	085	13·6	3	909
26·6	4	81558	24·3	4	370	22·4	4	874	20·8	4	117	19·4	4	134	18·2	4	955
33·2	5	624	30·4	5	431	28·0	5	930	26·0	5	169	24·3	5	182	22 7	5	98000
39·8	6	690	36·5	6	491	33·7	6	986	31·3	6	221	29·2	6	231	27·3	6	046
46·5	7	757	42 6	7	85552	39·3	7	89042	36·5	7	273	34·0	7	279	31·8	7	091
53·1	8	823	48·6	8	612	44·9	8	098	41·7	8	324	38·9	8	328	36 4	8	137
59·8	9	889	54·7	9	673	50·5	9	154	46·9	9	376	43·7	9	376	40·9	9	182
	660	954		720	733		780	209		840	428		900	424		960	227
6·5	1	82020	6·0	1	794	5·6	1	265	5·1	1	480	4·8	1	472	4·5	1	272
13 1	2	086	12·0	2	854	11·1	2	321	10·3	2	92531	9·6	2	95521	9·0	2	318
19 6	3	151	18·0	3	914	16·6	3	376	15·4	3	583	14·4	3	569	13·5	3	363
26·2	4	217	24·0	4	974	22·2	4	432	20·6	4	634	19·2	4	617	18·0	4	408
32 7	5	282	30·0	5	86034	27·7	5	487	25·7	5	686	24·0	5	665	22·5	5	453
39·2	6	347	36·0	6	094	33·2	6	89542	30·8	6	737	28·8	6	713	27·0	6	498
45·8	7	413	42 0	7	153	38·8	7	597	36·0	7	788	33·6	7	761	31·5	7	99543
52·3	8	478	48 0	8	213	44·3	8	653	41·1	8	840	38·4	8	809	36·0	8	588
58·9	9	82543	54·0	9	273	49·9	9	708	46·3	9	891	43·2	9	856	40·5	9	632
	670	607		730	332		790	763		850	942		910	904		970	677
6·4	1	672	5·9	1	392	5·5	1	818	5·1	1	993	4·7	1	952	4·5	1	722
12·9	2	737	11·8	2	451	10·9	2	873	10·2	2	93044	9·5	2	999	8·9	2	767
19·3	3	802	17·7	3	86510	16·4	3	927	15·2	3	095	14·2	3	96047	13·4	3	811
25·8	4	866	23·6	4	570	21·9	4	982	20·3	4	146	19·0	4	095	17·8	4	856
32·2	5	930	29·5	5	629	27·3	5	90037	25·4	5	197	23·7	5	142	22·3	5	900
38·6	6	995	35·5	6	688	32·8	6	091	30·5	6	247	28·5	6	190	26·8	6	945
45·1	7	83059	41·4	7	747	38·3	7	146	35·6	7	298	33·2	7	237	31·2	7	989
51·5	8	123	47·3	8	806	43·8	8	200	40·6	8	349	38·0	8	284	35·7	8	99034
58·0	9	187	53·2	9	864	49·2	9	255	45·7	9	399	42·7	9	332	40·1	9	078
	680	251		740	923		800	309		860	450		920	379		980	123
6·3	1	315	5·8	1	982	5·4	1	363	5·0	1	93500	4·7	1	426	4·4	1	167
12·7	2	378	11·7	2	87040	10·8	2	417	10 0	2	551	9·4	2	473	8·8	2	211
19·0	3	442	17·5	3	099	16·2	3	472	15·1	3	601	14·1	3	96520	13·2	3	255
25·4	4	83506	23·3	4	157	21·6	4	90526	20·1	4	651	18·8	4	567	17·6	4	300
31·7	5	569	29·1	5	216	27·0	5	580	25·1	5	702	23·5	5	614	22·0	5	344
38·0	6	632	35·0	6	274	32·4	6	634	30·1	6	752	28·2	6	661	26·5	6	388
44·4	7	696	40·8	7	332	37·8	7	687	35 1	7	802	32·9	7	708	30·9	7	432
50·7	8	759	46·6	8	390	43·2	8	741	40·2	8	852	37·6	8	755	35·3	8	476
57·1	9	822	52·5	9	448	48·6	9	795	45 2	9	902	42·3	9	802	39 7	9	99520
	690	885		750	87506		810	849		870	952		930	848		990	564
6·2	1	948	5·8	1	564	5·3	1	902	5·0	1	94002	4·6	1	895	4·4	1	607
12·5	2	84011	11·5	2	622	10·7	2	956	9·9	2	052	9·3	2	942	8·7	2	651
18·7	3	073	17·3	3	679	16·0	3	91009	14·9	3	101	13·9	3	988	13·1	3	695
25·0	4	136	23·0	4	737	21·3	4	062	19·9	4	151	18·6	4	97035	17·4	4	739
31·2	5	198	28·8	5	795	26·6	5	116	24·8	3	201	23·2	5	081	21·8	5	782
37·5	6	261	34·6	6	852	32·0	6	169	29·8	6	250	27·9	6	128	26·2	6	826
43 7	7	323	40·3	7	910	37·3	7	222	34·8	7	300	32·5	7	174	30·5	7	870
50·0	8	386	46·1	8	967	42·6	8	275	39·8	8	349	37·2	8	220	34·9	8	913
56·2	9	448	51·8	9	88024	48·0	9	328	44·7	9	899	41·8	9	267	39·2	9	957

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0 deg.	Sine.	Tang	ℓsi.	ℓta.	Cos.		
			6·46		9·99		
0 0	0·0 0000	0000	373	373		90 0	
2	6·7 6476	6476	373	373		89 58	
4	7·0 6579	6579	373	373		56	
6	7·2 4188	4188	373	373		54	
8	7·3 6682	6682	373	373		52	
10	7 4 6373	6373	373	373		50	
12	7·5 4291	4291	373	373		48	
14	7·6 0985	0986	372	373		46	
16	7·6 6784	6785	372	373		44	
18	7·7 1900	1900	372	373	999	42	
20	7·7 6475	6476	372	373	999	40	
22	7·8 0615	0615	372	373	999	38	
24	7·8 4393	4394	372	373	999	36	
26	7·8 7870	7871	372	374	999	34	
28	7·9 1088	1089	372	374	999	32	
30	7·9 4084	4080	372	374	998	30	
32	7·9 6887	6889	372	374	998	28	
34	7·9 9520	9522	372	374	998	26	
36	8·0 2002	2004	372	374	998	24	
38	4350	4353	372	374	997	22	
40	6578	6581	372	375	997	20	
42	8696	8700	372	375	997	18	
44	8·1 0717	0720	371	375	996	16	
46	2647	2651	371	375	996	14	
48	4495	4500	371	376	996	12	
50	6268	6273	371	376	995	10	
52	7971	7976	371	376	995	8	
54	9610	9616	371	376	995	6	
56	8·2 1189	1195	371	376	994	4	
58	2713	2720	371	377	994	2	
1 0	4186	4192	370	377	993	89 0	
2	5609	5616	370	377	993	88 58	
4	6988	6996	370	378	992	56	
6	8324	8332	370	378	992	54	
8	9621	9629	370	378	992	52	
10	8·3 0879	0888	370	379	991	50	
12	2103	2112	370	379	990	48	
14	3292	3302	369	379	990	46	
16	4450	4461	369	380	989	44	
18	5578	5590	369	380	989	42	
20	6678	6689	369	380	988	40	
22	7750	7762	369	381	988	38	
24	8796	8809	368	381	987	36	
26	9818	9832	368	382	986	34	
28	8·4 0816	0830	368	382	986	32	
30	1792	1807	368	383	985	30	
32	2746	2762	367	383	984	28	
34	3680	3696	367	383	984	26	
36	4594	4611	367	384	983	24	
38	5489	5507	367	384	982	22	
40	6366	6385	366	385	982	20	
42	7226	7245	366	385	981	18	
44	8069	8089	366	386	980	16	
46	8896	8917	366	386	979	14	
48	9708	9729	365	387	979	12	
50	8·5 0504	0527	365	387	978	10	
52	1287	1310	365	388	977	8	
54	2055	2079	365	389	976	6	
56	2810	2835	364	389	975	4	
58	3552	3578	364	390	974	2	
2 0	8·5 4282	4308	364	390	974	88 0	

	Cosine.	Cot.	6·46 ℓcos	6·46 ℓcot	9·99	88 deg.

2 deg.	Sine.	Tang.	ℓsi.	ℓta.	Cos		
			6·46		9·99		
2 0	8·5 4282	4308	364	390	974	88 0	
2	4999	5027	363	391	973	87 58	
4	5705	5734	363	391	972	56	
6	6400	6429	363	392	971	54	
8	7084	7114	363	393	970	52	
10	7757	7788	362	393	969	50	
12	8419	8451	362	394	968	48	
14	9072	9105	362	395	967	46	
16	9715	9749	361	395	966	44	
18	8·6 0349	0384	361	396	965	42	
20	0973	1009	361	397	964	40	
22	1589	1626	360	397	963	38	
24	2196	2234	360	398	962	36	
26	2795	2834	360	399	961	34	
28	3385	3426	359	399	960	32	
30	3968	4009	359	400	959	30	
32	4543	4585	358	401	958	28	
34	5110	5154	358	402	956	26	
36	5670	5715	358	402	955	24	
38	6223	6269	357	403	954	22	
40	6769	6816	357	404	953	20	
42	7308	7356	357	405	952	18	
44	7841	7890	356	406	951	16	
46	8367	8417	356	406	949	14	
48	8886	8938	355	407	948	12	
50	9400	9453	355	408	947	10	
52	9907	9962	354	409	946	8	
54	8·7 0409	0465	354	410	944	6	
56	0905	0962	354	411	943	4	
58	1395	1453	353	411	942	2	
3 0	1880	1940	353	412	940	87 0	
2	2359	2420	352	413	939	86 58	
4	2834	2896	352	414	938	56	
6	3303	3366	351	415	936	54	
8	3767	3832	351	416	935	52	
10	4226	4292	351	417	934	50	
12	4680	4748	350	418	932	48	
14	5130	5199	350	419	931	46	
16	5575	5645	349	420	929	44	
18	6015	6087	349	421	928	42	
20	6451	6525	348	422	926	40	
22	6883	6958	348	423	925	38	
24	7310	7387	347	424	923	36	
26	7733	7811	347	425	922	34	
28	8152	8232	346	426	920	32	
30	8568	8649	346	427	919	30	
32	8979	9061	345	428	917	28	
34	9386	9470	345	429	916	26	
36	9789	9875	344	430	914	24	
38	8·8 0189	0277	344	431	913	22	
40	0585	0674	343	432	911	20	
42	0978	1068	342	433	909	18	
44	1367	1459	342	434	908	16	
46	1752	1846	341	435	906	14	
48	2134	2230	341	436	904	12	
50	2513	2610	340	437	903	10	
52	2888	2987	340	439	901	8	
54	3261	3361	339	440	899	6	
56	3630	3732	339	441	898	4	
58	3996	4100	338	442	896	2	
4 0	8·8 4358	4464	337	443	894	86 0	

	Cosine.	otan.	6·46 ℓcos	6·46 ℓcot.	9 99 Sine.	86 deg.

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4 deg.	Sine. Ind. 8	dif.10	Tangent. Ind. 8	dif.10	Cosine. 9·99	D.		7 deg.	Sine. Ind. 9	dif.10	Tangent. Ind. 9	dif.10	Cosine. 9·99	D.	
4 0	84358		84464		994	9	86 0	7 0	08359		08914		875	16	83 0
3	897	1795	85006	1804	891	9	85 57	3	897	1025	09227	1041	670	16	82 57
6	85429	1773	540	1792	889	9	54	6	09202	1018	537	1033	666	16	54
9	955	1752	86069	1761	886	9	51	9	506	1011	845	1026	661	16	51
12	86474	1731	591	1740	883	9	48	12	807	1004	10150	1019	656	16	48
15	987	1710	87106	1719	880	9	45	15	10106	994	454	1010	651	16	45
18	87494	1690	616	1700	878	9	42	18	402	990	756	1006	647	16	42
21	995	1670	88120	1680	875	10	39	21	697	983	11056	999	642	16	39
24	88490	1651	618	1661	872	10	36	24	990	978	353	992	637	16	36
27	980	1633	89111	1642	869	10	33	27	11281	969	649	986	632	16	33
30	89464	1614	598	1624	866	10	30	30	570	963	943	979	627	17	30
33	943	1596	90080	1606	863	10	27	33	867	956	12235	973	622	17	27
36	90417	1579	557	1589	860	10	24	36	12142	950	525	967	617	17	24
39	985	1562	91029	1572	857	10	21	39	425	944	813	961	612	17	21
42	91349	1545	495	1555	854	10	18	42	706	937	13099	955	607	17	18
45	807	1528	957	1539	851	10	15	45	985	931	384	948	601	17	15
48	92261	1512	92414	1523	847	11	12	48	13263	925	637	943	596	17	12
51	710	1497	866	1507	844	11	9	51	539	919	948	937	591	17	9
54	93154	1481	93313	1492	841	11	6	54	813	913	14227	931	586	18	6
57	594	1466	756	1477	838	11	3	57	14085	907	504	925	581	18	3
5 0	94030	1451	94195	1462	834	11	85 0	8 0	356	904	780	921	575	18	82 0
3	461	1437	630	1448	831	11	84 57	3	624	896	15054	914	570	18	81 57
6	887	1423	95060	1434	828	11	54	6	891	890	327	906	565	18	54
9	95310	1409	486	1420	824	11	51	9	15157	885	598	903	559	18	51
12	728	1395	908	1406	821	12	48	12	421	879	867	897	554	18	48
15	96143	1381	96329	1393	817	12	45	15	683	874	16135	892	548	18	45
18	553	1368	739	1380	814	12	42	18	944	869	401	887	543	18	42
21	960	1355	97150	1367	810	12	39	21	16203	863	665	882	537	19	39
24	97363	1343	556	1354	807	12	36	24	460	858	928	877	532	19	36
27	762	1330	959	1342	803	12	33	27	716	853	17190	872	526	19	33
30	98157	1318	98358	1330	800	12	30	30	970	848	450	867	520	19	30
33	549	1306	759	1318	796	12	27	33	17223	843	706	862	515	19	27
36	937	1294	99145	1307	792	12	24	36	474	838	965	857	509	19	24
39	99322	1283	534	1295	788	12	21	39	724	833	18221	852	503	19	21
42	704	1271	919	1284	785	13	18	42	973	828	475	847	497	19	18
45	00082	1260	00301	1273	781	13	15	45	18220	823	728	843	492	20	15
48	456	1249	679	1262	777	13	12	48	465	817	979	836	486	20	12
51	928	1238	01055	1251	773	13	9	51	709	814	19229	833	480	20	9
54	01196	1228	427	1241	769	13	6	54	952	809	476	829	474	20	6
57	516	1217	796	1230	765	13	3	57	19193	804	725	824	468	20	3
6 0	923	1207	02162	1220	761	13	84 0	9 0	433	800	971	820	462	20	81 0
3	02283	1197	525	1210	757	13	83 57	3	672	795	20216	815	456	20	80 57
6	639	1187	885	1200	753	14	54	6	909	791	459	811	450	20	54
9	992	1177	03242	1191	749	14	51	9	20145	787	701	807	444	20	51
12	03342	1168	597	1181	745	14	48	12	380	782	942	803	438	20	48
15	690	1158	948	1172	741	14	45	15	613	778	21182	798	432	20	45
18	04034	1149	04297	1163	737	14	42	17	845	774	420	794	425	21	42
21	376	1140	643	1154	733	14	39	21	21076	769	657	790	419	21	39
24	715	1131	987	1145	728	14	36	24	306	765	893	786	413	21	36
27	05052	1122	05328	1136	724	14	33	27	534	761	22127	782	407	21	33
30	386	1113	666	1127	720	14	30	30	761	757	361	778	400	21	30
33	717	1104	06002	1119	716	15	27	33	987	753	593	774	394	21	27
36	06046	1096	335	1111	711	15	24	36	22211	749	824	770	388	21	24
39	372	1088	666	1102	707	15	21	39	435	745	23054	766	381	21	21
42	696	1080	994	1094	702	15	18	42	657	741	283	763	375	22	18
45	07018	1071	07320	1086	698	15	15	45	878	737	510	759	368	22	15
48	337	1063	643	1078	693	15	12	48	23098	733	737	755	362	22	12
51	653	1055	964	1071	689	15	9	51	317	730	962	751	355	22	9
54	968	1048	08283	1063	684	15	6	54	535	726	24186	748	348	22	6
57	08280	1040	600	1056	680	15	3	57	752	722	410	744	342	22	3
7 0	589	1033	914	1048	675	15	83 0	10 0	967	718	632	740	335	22	80 0
	Ind. 9 Cosine.	dif.10	Ind. 9 Cotangent.	dif.10	9·99 Sine.	D.	83 deg.		Ind. 9 Cosine.	dif.10	Ind. 9 Cotangent.	dif.10	9·99 Sine.	D.	80 deg.

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10 deg	Sine. Ind. 9.	dif. 10	Tangent. Ind. 9	dif. 10	Cosine. 9·99	D.		15 deg.	Sine. Ind. 9	dif. 10	Tangent. Ind. 9.	dif. 10	Cosine. Ind. 9.	D.	
10 0	23967	713	24632	736	335	22	80 0	15 0	41300	468	42805	503	98494	34	75 0
5	24324	707	25000	730	324	23	79 55	10	768	464	43309	498	460	34	74 50
10	677	702	365	724	313	23	50	20	42232	458	806	493	426	35	40
15	25028	696	727	719	301	23	45	30	690	453	44299	488	391	35	30
20	376	690	26086	713	290	23	40	40	43148	448	787	484	356	36	20
25	721	684	443	708	278	23	35	50	591	443	45271	479	320	36	10
30	26063	679	797	702	267	24	30	16 0	44034	438	750	474	284	36	74 0
35	403	673	27148	697	255	24	25	10	472	433	46224	470	248	37	73 50
40	739	668	496	692	243	24	20	20	905	429	694	466	211	37	40
45	27073	663	842	687	231	24	15	30	45334	424	47160	462	174	38	30
50	405	658	28186	682	219	24	10	40	758	420	632	458	136	38	20
55	734	652	527	677	207	24	5	50	46178	416	48080	454	098	38	10
11 0	28060	647	865	672	195	25	79 0	17 0	594	411	534	450	060	39	73 0
5	384	642	29201	667	182	25	78 55	10	47005	406	934	446	021	39	72 50
10	705	638	535	663	170	25	50	20	411	403	49430	442	97982	40	40
15	29024	633	866	658	157	25	45	30	814	399	872	439	942	40	30
20	340	628	30195	653	145	25	40	40	48213	394	50311	435	902	40	20
25	654	623	522	649	132	25	35	50	607	391	746	432	861	41	10
30	966	619	846	644	119	26	30	18 0	998	387	51178	428	821	41	72 0
35	30275	614	31168	640	106	26	25	10	49385	383	606	425	779	41	71 50
40	582	610	489	636	093	26	20	20	768	380	52031	421	738	42	40
45	887	605	806	632	080	26	15	30	50148	375	452	418	696	42	30
50	31189	601	32122	627	067	27	10	40	523	372	870	415	653	43	20
55	490	596	436	623	054	27	5	50	896	368	53285	412	610	43	10
12 0	788	592	747	619	040	27	78 0	19 0	51264	365	697	409	567	44	71 0
5	32084	588	33057	615	027	27	77 55	10	629	362	54106	406	523	44	70 50
10	378	584	365	611	013	27	50	20	991	359	512	403	479	44	40
15	670	580	670	607	000	27	45	30	52350	355	915	400	435	45	30
20	960	576	974	604	986	28	40	40	705	351	55315	397	390	45	20
25	33248	572	34276	600	972	28	35	50	53056	349	712	395	344	46	10
30	534	568	576	596	958	28	30	20 0	405	346	56107	391	299	46	70 0
35	818	564	874	592	944	28	25	10	751	342	498	389	252	47	69 50
40	34100	560	35170	589	930	28	20	20	54093	340	887	387	206	47	40
45	380	556	464	585	916	29	15	30	433	336	57274	384	159	48	30
50	658	553	757	582	901	29	10	40	769	333	658	381	111	48	20
55	934	549	36047	578	887	29	5	50	55102	331	59039	379	063	48	10
13 0	35209	545	336	575	872	29	77 0	21 0	433	328	418	376	015	49	69 0
5	481	542	624	571	858	29	76 55	10	761	324	794	374	96966	49	68 50
10	752	538	909	568	843	30	50	20	56085	323	59168	372	917	49	40
15	36022	535	37193	565	828	30	45	30	405	319	540	369	868	50	30
20	289	531	476	561	813	30	40	40	727	317	909	367	818	51	20
25	555	528	756	558	798	30	35	50	57044	314	60276	365	767	51	10
30	819	524	38035	555	783	30	30	22 0	358	311	641	363	717	51	68 0
35	37081	521	313	552	768	31	25	10	669	309	61004	360	665	52	67 50
40	341	518	589	549	753	31	20	20	978	306	364	358	614	52	40
45	600	515	863	546	737	31	15	30	58284	304	722	357	562	53	30
50	858	511	39136	543	722	31	10	40	588	301	62079	354	509	53	20
55	38113	508	407	540	706	31	5	50	889	299	433	352	456	53	10
14 0	368	505	677	537	690	32	76 0	23 0	59188	296	785	350	403	54	67 0
5	620	502	945	534	675	32	75 55	10	484	294	63135	349	349	54	66 50
10	871	499	40212	531	659	32	50	20	778	292	484	346	294	54	40
15	39121	496	478	528	643	32	45	30	60070	289	830	345	240	55	30
20	369	493	742	525	627	32	40	40	359	287	64175	342	185	56	20
25	615	490	41005	522	610	32	35	50	646	285	517	341	129	56	10
30	860	487	266	520	594	33	30	24 0	931	283	858	339	073	56	66 0
35	40103	484	526	517	578	33	25	10	61214	280	65197	338	017	56	65 50
40	346	481	784	514	561	33	20	20	494	279	535	335	95969	57	40
45	586	478	42041	512	545	33	15	30	773	276	870	334	902	58	30
50	825	476	297	509	528	34	10	40	62049	274	66204	333	841	58	20
55	41063	473	552	507	511	34	5	50	323	272	537	330	786	58	10
15 0	300		805		494		75 0	25 0	595		867		728		65 0
	Ind. 9	dif. 10	Ind. 9	dif. 10	9·98	D.	75		Ind. 9	dif. 10	Ind. 9	dif. 10	Ind. 9	D.	65
	Cosine.		Cotangent.		Sine.		deg.		Cosine.		Cotangent.		Sine.		deg.

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25 deg.	Sine. Ind. 9	dif.	Tangent. Ind. 9	dif.	Cosine. Ind. 9	D.		35 deg.	Sine. Ind. 9	dif.	Tangent. Ind. 9	dif.	Cosine. Ind. 9	dif.	
25 0	62595	270	66867	329	95728	59	65 0	35 0	75859	180	84523	268	91336	89	55 0
10	865	268	67196	328	668	60	64 50	10	76039	179	791	268	248	89	54 50
20	63133	265	524	326	609	60	40	20	218	177	85059	268	158	90	40
30	398	264	850	324	549	61	30	30	395	177	327	267	069	91	30
40	662	262	68174	323	488	61	20	40	572	175	594	266	90978	91	20
50	924	260	497	321	427	61	10	50	747	175	860	266	887	91	10
26 0	64184	258	818	320	366	62	64 0	36 0	922	173	86126	266	796	92	54 0
10	442	256	69138	319	304	62	63 50	10	77095	173	392	265	704	93	53 50
20	698	255	457	317	242	62	40	20	268	171	656	265	611	93	40
30	953	252	774	315	179	63	30	30	439	170	921	264	518	94	30
40	65205	251	70089	315	116	63	20	40	609	169	87185	263	424	94	20
50	456	249	404	313	052	64	10	50	778	168	448	263	330	95	10
27 0	705	247	717	311	94988	64	63 0	37 0	946	167	711	263	235	96	53 0
10	952	245	71028	311	923	65	62 50	10	78113	167	974	262	139	96	52 50
20	66197	244	339	309	858	65	40	20	280	165	88236	262	043	97	40
30	441	241	648	307	793	65	30	30	445	164	498	261	89947	97	30
40	682	240	955	307	727	66	20	40	609	163	759	261	849	98	20
50	922	239	72262	305	660	67	10	50	772	162	89020	261	752	99	10
28 0	67161	237	567	305	593	67	62 0	38 0	934	161	281	260	653	99	52 0
10	398	235	872	303	526	67	61 50	10	79095	161	541	260	554	100	51 50
20	633	233	73175	301	458	68	40	20	256	159	801	260	455	100	40
30	866	232	476	301	390	68	30	30	415	158	061	259	354	101	30
40	68098	230	777	300	321	69	20	40	573	158	320	258	254	101	20
50	328	229	74077	298	252	69	10	50	731	156	90578	259	152	102	10
29 0	557	227	375	298	182	70	61 0	39 0	887	156	837	258	050	102	51 0
10	784	226	673	296	112	70	60 50	10	80043	154	91095	258	88948	103	50 50
20	69010	224	969	295	041	71	40	20	197	154	353	257	844	104	40
30	234	222	75264	294	93970	71	30	30	351	153	610	256	741	104	30
40	456	221	558	294	898	72	20	40	504	152	868	257	636	105	20
50	677	220	852	292	826	72	10	50	656	151	92125	256	531	105	10
30 0	897	218	76144	291	753	73	60 0	40 0	807	150	381	257	425	106	50 0
10	70115	217	435	290	680	73	59 50	10	957	149	638	256	319	106	49 50
20	332	215	725	290	606	74	40	20	81106	148	894	256	212	107	40
30	547	214	77015	288	532	74	30	30	254	148	93150	256	105	107	30
40	761	212	303	288	457	75	20	40	402	147	406	256	87996	109	20
50	973	211	591	286	382	75	10	50	549	145	661	255	887	109	10
31 0	71184	209	877	286	307	76	59 0	41 0	694	145	916	255	778	109	49 0
10	393	209	78163	285	230	77	58 50	10	839	144	94171	255	668	110	48 50
20	602	207	448	284	154	77	40	20	983	143	426	255	557	111	40
30	809	205	732	283	077	78	30	30	82126	143	681	255	446	111	30
40	72014	204	79015	282	92999	78	20	40	269	141	935	254	334	112	20
50	218	203	297	282	921	79	10	50	410	141	95190	255	221	113	10
32 0	421	201	579	281	842	79	58 0	42 0	551	140	444	254	107	114	48 0
10	622	201	860	280	763	80	57 50	10	691	139	698	254	86993	114	47 50
20	823	199	80140	279	683	80	40	20	830	138	952	254	879	115	40
30	73022	197	419	278	603	81	30	30	968	138	96205	253	763	116	30
40	219	197	697	278	522	81	20	40	83106	136	459	254	647	116	20
50	416	195	975	277	441	82	10	50	242	136	712	253	530	117	10
33 0	611	194	81252	276	359	82	57 0	43 0	378	135	966	254	413	117	47 0
10	805	192	528	276	277	83	56 50	10	513	135	97219	253	295	118	46 50
20	997	192	803	275	194	83	40	20	648	133	472	253	176	119	40
30	74189	192	82078	275	111	83	30	30	781	133	725	253	056	120	30
40	379	190	352	274	027	84	20	40	914	133	978	253	85936	120	20
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34 0	756	188	899	273	857	85	56 0	44 0	177	131	484	253	693	122	46 0
10	943	187	83171	272	772	85	55 50	10	308	131	737	253	571	122	45 50
20	75128	185	442	271	686	86	40	20	437	129	989	252	448	123	40
30	313	185	713	271	599	87	30	30	566	129	99242	253	324	124	30
40	496	183	984	271	512	87	20	40	694	128	495	253	200	124	20
50	678	182	84254	270	425	87	10	50	822	128	747	252	076	125	10
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Cosine.		Cotangent.		Sine.		deg.		Cosine.		Cotan			deg.

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PREVENTION OF STEAM-BOILER EXPLOSIONS.

We copy the following sensible letter from the *Staffordshire Advertiser*, of the 8th instant, a copy of which has been obligingly sent to us by the writer. We wish he would also favour us with some account of his "little steam-carriage, 'The Triumph,'" of which he here makes mention. In a postscript to a letter which we have received from him on another subject, he says, "I have been two years the possessor of a small carriage that will carry myself in plain wheels up an inclined plane *rising six inches in every yard.*" If this be the carriage alluded to, it may well be called *The Triumph.*

"Govern these vantages with your finger and thumb."

SHAKSPEARE.

"Sir—As I trust the time is fast approaching when we shall see carriages propelled by steam traversing our common roads in all directions—but at what speed I dare not undertake to say; and as there is a very prevalent feeling of dislike to, or fear of their introduction, on account of apprehended dangers from explosion of the boilers, I have no doubt you will feel a pleasure in assisting to disperse as widely as possible the following most simple and efficacious preventive.

"Your readers may suppose the invention to have arisen out of the following familiar occurrence, which forms the strongest illustration that I can give of its principles and efficacy.

"A narrow-mouthed stone-ware jar, filled with fruit, and closed by a bladder, was placed in a kettle of boiling water to stew. The syrup of the fruit soon became as hot as the water, and then steam began to form, which having no vent, at last burst the bladder and escaped. Now, had the bladder been as strong as the jar, the steam would have been confined until its strength became sufficient to burst the jar, and discharge at once its whole contents, the consequences of which may easily be imagined.

"On the top of my boiler, in addition to the usual safety valves, I place a pipe of dimensions sufficient to discharge the steam gradually. The orifice of this pipe I cover with a plate of thin sheet-lead, strong enough to hold steam of proper working strength. Now, should any cause obstruct or overload the safety valves, as soon as the steam becomes too strong the sheet lead tears asunder and discharges it. It is impossible to burst the boiler. This, I believe, wants no science to make it plain—any one may understand it; a report will be heard, and the journey will be delayed, but no damage can ensue.

"Even the "great steam-chamber (A), alias safety-chamber, alias danger-chamber," about which there was so much bickering, a few months ago, in the "Mechanics' Magazine" and the "Register of Arts," will become, with this appendage, quite harmless.

"Such is the safety of this simple contrivance, that I think it would not be unworthy the notice of Parliament, making it penal for a boiler to be found without it, at the same time regulating the size of the orifice and thickness of the lead.

"This security is attached to the boiler of my little steam-carriage, 'The Triumph,' heretofore noticed in your columns; the pipe is one inch diameter, and the lead about the thickness of brown paper.

"It seems my rivals in steam-travelling on common roads are breaking down fast, leaving a clearer course for me on which either to expose the presumption of my competition or to win the prize. Anderson and James were to have carried the mails in October last, and Gurney was positively to begin to work for the public in March—but according to Mr. Herapath's letter in *The Times* of the 23rd April, he is 'scotched' by the law. "A writ of error," I guess.

"Mr. Gurney is an indefatigable man, and must build anew; for I can tell him a plain truth, that his present carriage will only travel on level, or nearly level ground; it has not strength to work over a two-inch stone at a dead pull, as I expect will be abundantly proved when the principles of 'The Triumph' come to be laid before your readers.

"Yours, &c.

"SAXULA.

"*May* 5, 1830."

Enquiries.

A constant supply of water is wanted in a cistern 16 feet above the surface of a pond from which there is a fall through a 2-inch pipe of 4 feet. What is the most simple mode of obtaining such supply?

A SUBSCRIBER.

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Has Darwin's machine for raising water ever been put in practice?

A SUBSCRIBER.

What is the best method of tempering rupture truss-springs (stout and slight); the degree of heat best adapted for hardening; the ingredients for tempering; and the cheapest and best kind of steel (if in sheets or not).

A YOUNG TRUSS-MAKER.

What is the best and most approved method of mounting a Newtonian telescope of 5-feet focus, so as not to be affected with tremors as such instruments generally are?

A SUBSCRIBER SINCE THE COMMENCEMENT.

What composition will cement silk, cotton, or leather, to pewter or tin, so as to resist the action of milk-warm water?

J. M.

A polish is wanted for articles in fancy leathers that is flexible and will not dull with the warm fingers; common white of egg being clammy.

A CONSTANT READER.

Where did Mr. Smeaton erect any water or windmills? I am desirous of contrasting their effects with mills made on plans differing (slightly in some, but widely in others) from his given rules, but which yet do their work exceedingly well; whilst, in one or two instances, water-mills, made somewhat after his advice, do not do so.

Z.

If into the side of a reservoir of water, 30 feet below the surface, there be inserted a pipe, one inch diameter in the bore, at the point of insertion, but gradually, becoming wider and wider as it proceeds; the axis of the pipe being *perfectly horizontal throughout*, it is required to be determined how much increase of diameter will be necessary for every English mile in length, so as at any distance, great or little, if the pipe be filled and shut up at the farther end, an orifice half an inch in diameter, made in the middle of the end, will always, *at any distance* from the reservoir, deliver *precisely the same quantity of water* as at any other distance.

AN EMIGRANT.

Sir,—Notwithstanding all that has been written on the subject of paddle-wheels, and much as this interesting topic has engrossed the minds of many ingenious men, who have desired various schemes for feathering the paddles, or, in other words, to lessen the great waste of power expended; I am well persuaded that the wheel itself, from its situation and other causes, is *not* the best means of propelling. I am in the course of making experiments, and as, in the first place, it is necessary to know the different degrees of resistance that water will afford at different depths, I have consulted Tredgold, and, I believe, *all the* authors who have written on steam navigation, without a satisfactory result. Perhaps some of your numerous correspondents may be able to point out where I can gain the information I want, for it appears to me that water low down affords a better *fulcrum* than when it is agitated and broken on the surface; and that the machinery necessary may be smaller in proportion. Theorists may say the contrary, and that a body moving *on the surface* has in addition to the resistance an accumulation of water higher in front than behind, which is not the case far under water. But I know from experience that any protuberance on a vessel's bottom *low down*, such as the false keel, being displaced, or copper torn by striking the ground, has a *much greater* effect in retarding the ship's way, than the same (such as a cleet nailed on, &c.) near the surface with the same square of resistance. What I want is a proof of practical experiments if they exist, as they are troublesome to make.

I am, Sir,
Yours, &c.
NAUTICUS.

London, May 12, 1830.

MINOR CORRESPONDENCE.

Tables of Natural Versed Sines.—Sir, As your correspondent, Mr. Anthony Peacock, ("Mechanics' Magazine," No. 321, p. 104), is a teacher of navigation, it may be of use to inform him, that there is an appendix published to the 3rd edition of the "Requisite Tables," consisting of new tables of natural sines, natural versed sines, and logarithms, to six places of decimals. The sines are given to every second, and the proportional parts of the three tables are arranged in a most convenient manner. The tables occupy 106 pages octavo, and the explanations 6 pages more. The price of the whole, if I rightly remember, is only two shillings!—I remain, Sir,

Your constant reader,

A. MERRIOR.

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Air-Pump Improvements.—Sir, In the last part of your Magazine I perceive there is an account of various improvements in the air-pump; and, among others, one is stated to be an improved method of letting the air into the exhausted receiver by means of a communication through the screw in front of the pump. Now, I do not know whether your correspondent claims the credit of the invention, but if so, he is mistaken, as I have an air-pump in my possession made by Mr. Huntley, of Oxford-street, in which precisely the same plan is made use of. It was purchased about six months ago.

I am, &c.

ANOTHER LOOKER-ON.

Chelmsford, May 10, 1830.

P. S.—I beg to hint to your correspondents, that they should state where such improvements on new inventions they describe may be obtained, and the price. There was one mentioned in your last Part, which I wished to have, but do not know where to go to for it.

Mr. Gilbert's Algebraical Problem.—"Respecting the question I lately proposed, and the lemma attached to it, I may remark, that the question is only a generalization of one proposed in "Bonnycastle's Algebra;" and that the lemma being probably new, affords a method of solving such questions, different from any before practised, which latter was the only reason that induced me to send the question. The redundancy mentioned was accidental; I did not intend that the lemma should be printed at the same time with the question; although, through haste in writing, the manner in which I expressed myself probably indicated that design. It should have been stated at the end of the question that it was "to be solved by a new method."—J. GILBERT, Jun.

Omicron's Question.—Sir, The problem by Omicron in the 329th Number of your very entertaining Magazine I find solved in the 347th Number by several gentlemen whose results agree, according as the problem is considered, whether *integrally* or *integrally and decimally*. For my own part, I never looked upon it otherwise than the latter, and that the hypothenuse was intended as "one million feet and one-millionth part of a foot," and the base "two-millionth parts of a foot less." I must agree with Omicron that the problem is simple and rather curious, particularly as by one method of working it, in squaring the base there appear neither in the operation or product a 2, 3, 4, 5, 6, or 7, only one 8, thirteen 1's, and one hundred and forty-three 9's. However, as the triangle is now formed, I shall be glad if Omicron, or some one else, will be kind enough "*to give the angle at the base.*"—I am, Sir,

Your obedient servant,

TEMPORA.

Kentish Town, May 8, 1830.

Necessity of Air to Life.—Sir, I have heard, and read, that a human being (full grown, I suppose,) consumes a gallon of air a minute; that is, the blood, in its passage through the lungs of a human being, imbibes every minute the whole of the oxygen contained in a quantity of air equal in capacity to that of a gallon. Upon this principle, a few evenings ago, in the company of a few friends, I stated and adhered to the position, that if a man be shut up in a room, the floor, walls, and ceiling of which should be composed of some substance completely impervious to the air, and the room hermetically closed; if a man were shut up in such a room, of any dimensions, he could not exist a greater number of minutes than there should be gallons in the capacity of the room. I contended, that the principle is the same, whether applied to 1 gallon or 10,000, or any greater number of gallons. My friends expressing themselves more than doubtful of the correctness of my opinion, we agreed to submit the subject to your decision, or to the consideration and judgment of your numerous and enlightened readers.—I am, Sir, &c.

R. J.

[We pronounce our correspondent to have been theoretically in the right. No person can exist a moment longer than the quantity of oxygen necessary to existence is supplied; but we are not prepared to say that the duration of life under the circumstances supposed can be calculated to an arithmetical nicety. The quantity of air necessary to vitality in man has never yet been positively determined; and there is every reason to suppose that it varies with the size of individuals and with the quickness of the circulation. We submit the case, however, to the consideration of our readers, and should we receive any communication calculated to throw light on the subject, shall readily give it a place.—ED. M. M.]

Thorold's Locomotive-Carriage.—Sir, Your correspondents A. Z. and J. J. Cole have not made themselves acquainted with the details of my locomotive-carriage. A. Z. says, two cylinders perhaps would obviate the difficulty he complains of; by reference to the plans, p. 34, it will be seen that No. 5 shows a bird's-eye view of two cylinders. I think, by attaching ratchets like those shown in the American carriage, November 21, 1829, the thing will be done. J. J. Cole is perfectly in the dark as to the action when he recommends a lever, &c.; and I beg him to read Mr. W. Wood's treatise on railroads.—I am, &c.

W. THOROLD.

Norwich, May 18, 1830.

MISCELLANEOUS.

The Climbing Boy System.—Application having been lately made by the secretary of the Society for the Suppression of the Climbing Boy System, to the directors of St. George's Hospital to employ the Society's agents in cleansing the flues of that establishment, the following order was given by the Board—"Let a fair trial be made of all the flues, in the presence of Bentley, the sweep, and if the machine is found to answer the work shall be put into the hands of the society." Accordingly the 24th of April last was fixed upon for the experiment, and Bentley, his son, and three boys, were met by Glass and Day (the Society's agents) and two of their men, and the following terms were agreed upon, viz. that the first chimney should be swept by Glass's machine, and that when this was finished, one of Bentley's boys should be sent up with his brush and scraper: then that the next chimney should be first swept by a boy, and afterwards by the machine, and so on alternately, till the whole (eighteen in number) were completed. The result was most conclusive in favour of the machine; it being agreed by all present that the soot which was brought down by the boys after the machine was one-fifth less than the quantity brought down by the machine after the boys.

The Draw Loom.—We learn that a very ingenious improvement in the construction of the draw loom, by which the weaver will be enabled to mount one at a comparatively trifling expense, has lately been invented by Wm. Waddeley, weaver, at Springburn, in the vicinity of Glasgow. In his draw loom the whole box and carriage, the most expensive part of the apparatus, are superseded by three small rollers, on two of which the harness is suspended, and the

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other preserves the tail cords in a horizontal position during the pull of the simple. By this contrivance the great crossing at the neck of the harness is avoided; and consequently from the half to two-thirds of the weight of lead will be saved, as well as a considerable part of the tail twine. This must be a very important discovery at the present time, both to the manufacturer and weaver, when harness work, particularly zebras, are much in demand; and certainly has a claim on those interested for some remuneration to the ingenious inventor.—*Glasgow Chronicle.*

Abuse of Patents.—In the time of Elizabeth the multiplication of letters-patent for monopolies of particular branches of trade had become an excessive public grievance. Almost every thing was the subject of a patent—even such articles as salt, brushes, bottles, starch, rosin, skins, felts, leather, &c. There was one for making saltpetre, which was the most outrageous of any. It gave the patentees the power of entering into any private house, cellar, stable, or other place where nitrous matter could be gathered, and to dig and carry away without limitation! In 1601, the Parliament sent an address to the Queen, representing the grievous oppression suffered under these patents; in consequence of which, some of them were revoked, and during the remainder of her Majesty's reign not many more granted. In the reign of her successor, however, things became worse than ever in this respect, and Parliament found it at last necessary for the protection of the freedom of trade, to pass the famous and most excellent Statute of Monopolies, by which all patents for other than new inventions and improvements are declared illegal, and the Crown is restrained from granting any patent for a longer term than 14 years.

The Steam-Engine.—In 1788, an account was taken of the work performed by seventeen engines on Mr. Watt's construction, then working in Cornwall. Their average duty was 19,569,000 pounds raised one foot high by one bushel of coal, which exceeds the performances of the former atmospheric engines in the proportion of 2·78 to 1. Some years after disputes having arisen as to the real performance of Mr. Watt's engines, the matter was referred to five gentlemen, of whom Mr. Davies Gilbert was one; and in May, 1798, these arbiters made their award. The general average of twenty-three engines was 17,671,000. Since that period, so great have been the improvements in the economy of fuel, and other parts of the machinery, that in December, 1829, the duty of the best engine, with a cylinder of 80 inches, was 75,628,000, exceeding the duty performed in 1795 in the proportion of 3·865 to 1, and that of the old atmospheric engine in the proportion of 10·75 to 1.

Solar Tides.—Kotzebue, in the account of his recent voyage round the world, mentions that "the ebb and flood vary essentially from the general rule in the bight of Materai (Otaheite), where they seem to have but little respect for the moon, to whom the tides are elsewhere subservient. Throughout the year the water stands at its highest elevation at the moment when the sun has reached the meridian; and it falls with the declination of the sun until midnight. This occurrence, as well as the position of the sun, makes amends to the inhabitants for the want of clocks or watches; although the elevation and depression of the sea do not exceed a few feet."

Improvement in Lithography.—Senefelder, the inventor of this art, is now at Stutgard, where he is busily employed in bringing to perfection a new invention, which is of the following nature. By means of a single plate, he prints off a painting in oils, and is then enabled to illuminate either an engraving on copper or from stone, in all the modifications of its shadings. We are told, that he has already made such progress with this invention as to afford the promise of results, which bid fair to form an era in the art of illuminating prints. He has also invented artificial plates of stone, which are a most essential improvement upon the natural plates hitherto made use of; inasmuch as their portability and cheapness will greatly reduce the expense of the plates, and at the same time give facilities of transmission and carriage, which the ponderous stones at present employed have never possessed.—*Athenæum.*

Flies.—Laurel oil, if applied to the walls and doors of places where meat is kept, has been found effectual to keep off flies.

Continental Fire Associations.—In several of the cities of Germany, and particularly on the borders of the Rhine, the whole of the householders of the district are members of a society for the extinction of fires, as well organized, as thoroughly drilled, and subject to as severe regulation as our local militia or volunteers. The sound of the fire alarm-bell calls each man to his post; the subdivision of labour is made; the nature and duties of that labour are known; system and science, we may say, pervade the whole of their movements; seldom, if ever, does the fire extend beyond the place in which it originates, and very frequently is it extinguished without much mischief to the house in which it breaks out. It is a system and an association of this kind that we require in London.—*Morning Chronicle.*

Friction in Machinery.—A paper was lately read at the Royal Society by Davies Gilbert, Esq. the President, on "the methods best adapted for imparting great angular velocities." Equability of velocity is considered by the learned author to be best obtained, though at the expense of some degree of sliding friction, when the outline of the teeth of the wheels are involutes of circles. Friction, on the other hand, is wholly prevented when their form is logarithmetic spirals; but the angular volocities will then be variable. Hence these two advantages are incompatible with one another; but, on the whole, the author gives the preference to the involute, which produces an equability of angular motion. The most advantageous mode of increasing velocity by a series of wheels, is to adjust them so that the multiplication of velocity shall proceed in a geometrical progression.

INTERIM NOTICES.

The Subscribers to the "Mechanics' Magazine" will each receive, along with the present Number, a free copy of a Companion to the Magazine, which the Editor has just commenced under the title of the "Spirit of Literature." The Editor begs respectfully to solicit an extension of their patronage and support to the new undertaking.

Communications received from Mr. Sinclair—J. L.—Abner Brand—Mr. Gilbert—A Member of the Caledonian Church—The Bath Mechanics' Institution—Vey—D. G. T.—Mr. Leigh—Plus—Silex—T. K.—S. Y.

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Mechanics' Magazine,

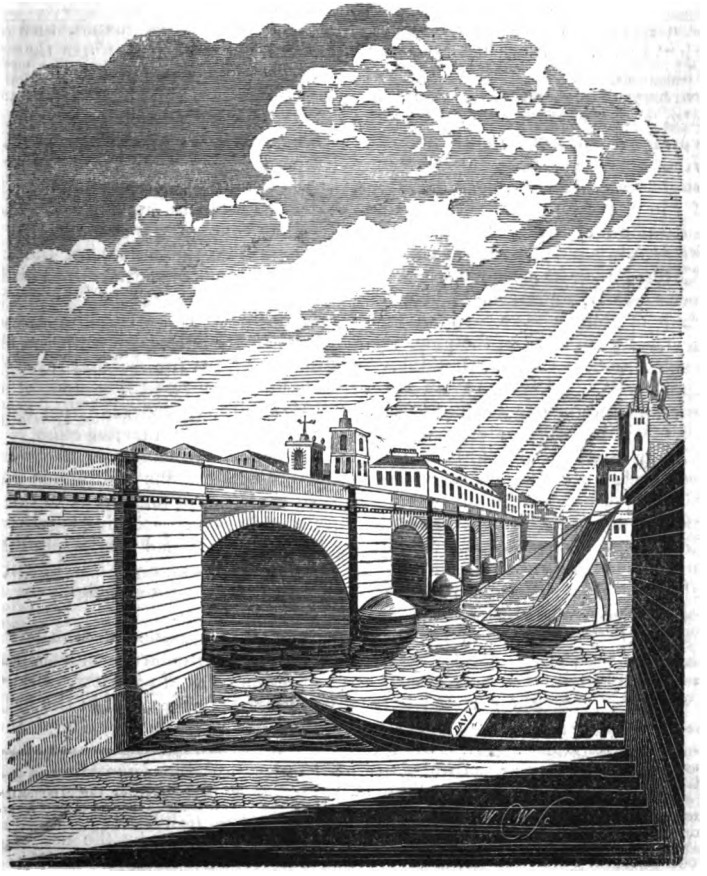
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 356.] SATURDAY, JUNE 5, 1830. [Price 3d.

"Art thrives most
Where Commerce has enrich'd the busy coast;
He catches all improvements in his flight,
Spreads foreign wonders in his country's sight;
Imparts what others have invented well,
And stirs his own to match them or excel.
'Tis thus reciprocating, each with each
Alternately the nations learn and teach;
While Providence enjoins to every soul
A union with the vast terraqueous whole."

COWPER.

VIEW OF NEW LONDON BRIDGE.



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DESCRIPTIVE ACCOUNT OF THE PRINCIPAL BRIDGES ERECTED OVER THE RIVER THAMES. BY MR. C. DAVY, ARCHITECT.

No. XIV.

On the Architecture of Stone-Bridges —Size of the largest Elliptical Arches in the Bridges over the Thames—Proportions of Piers—Dimensions of New London Bridge.

The slow and gradual increase in the size of stone-bridges, as well as the difficulty attending the execution even of the more diminutive structures of this kind—renders it important that we compare the dimensions of the most interesting, and their architectural characteristics. The essential and component parts of these structures differ not from those of ancient Rome, as from history we find that over the piers and arches were carriage and foot-ways, sometimes also sheltered from the weather by coverings similar to the Venetian Rialto. We have, however, only slight imitations of these coverings, for in proportion to the greater extent of traffic they would have been inconvenient in a country such as England. Covered recesses over piers are used occasionally, and seem to be a remnant of Roman taste. In an architectural point of view, the propriety of such erections cannot, I think, be questioned. They give an air of great importance to a structure when viewed from the water that is obviously wanting without them; they compensate for the apparent diminutiveness of height which most bridges necessarily have, from their great length and the arbitrary nature of the approaches thereto from the adjoining shores. This defect is particularly observable in Waterloo Bridge. The structure itself is pseudo-Grecian; and however dignified it might have appeared by itself, it suffers greatly in comparison with the elevated terrace and Italian façade of the water-front of Somerset House. Mr. Gwilt's design in this situation, provided with elliptical arches, would have been altogether as much in judicious keeping as the present building is *outré* from comparison.

It is a fact, and an unfortunate one, that in so expensive and majestic a structure as a bridge, great difficulty is experienced in adapting architectural decoration to the intended purpose. Something bold and well-defined must mark the situation of the piers, as the extent of the arches will effectually drown any trifling that may be attempted in the way of ornament. The *dilettanti* have at all times shown themselves excessively fastidious on the subject of architectural decoration proper for stone-bridges. Balustrades have been compared to "filigree-work;" and columns introduced before the piers have been designated as being fit for nothing else than for "little boys" to amuse themselves with by playing "bo-peep" behind them. A celebrated mathematical writer caught this mania, and declared in one of his works that the most elegant appearance would be obtained, by combining the "piers of Westminster Bridge and the arches of Blackfriars'." In a bridge the first thing that strikes the eye is the general outline; and, according to taste or circumstances, we have the triangular contour (Westminster), the straight line (Waterloo), or the continuous bend (Blackfriars'). This last may be reckoned the best for the following reasons:—1st. The angular lines do not harmonise with the form of the arches (unless they are of a Gothic form). 2nd. The straight line, if perfectly so, produces (from optical causes) in appearance, the effect of being bent in the middle in an inverted position, while the continuous curve gives an idea of magnitude in the extent of its radius—binding together, as it were, piers and arches, and harmonising completely with the curved line formed by the heights of the different arches.

There is a species of architectural ornament introduced with splendid effect, in point of propriety, at Somerset House Terrace, and in the beautiful little water-gate by Inigo Jones, not far distant from the same spot—it consists in the representation of petrifactions and rock-work, giving an appearance of architectural richness impossible to attain by the use of any other ornament where buildings are

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seen under such circumstances and situations.

The comparative dimensions of bridges executed in ancient and modern times will show in a perspicuous manner the great progress that has been made in the practical construction of these buildings. Ancient Rome boasted of having eight principal bridges, ranking, according to Gautier, in the following order:—1. Pons Ælius. 2. The triumphal bridge over the Tiber. 3. Pons Janiculensis. 4. Pons Cestius. 5. Pons Fabricius. 6. Pons Senatorius. 7. Pons Horaticus. 8. Pons Milvius. Interesting as these are from their antiquity and size, it will at the same time appear that they were not constructed according to correct scientific principles. The extraordinary thickness of the piers, to resist trifling thrusts, would show that investigation had not occupied their attention to any great extent. Add to this, the unnecessary height to which these buildings were carried—the Alcantara, on the Tagus, (the most celebrated of the Roman bridges), measuring 205 feet from the bed of the river to the road-way; and the height of the bridge near Narni, 102 feet. An attentive examination and admeasurement from the drawings and originals of the most ancient bridges combine to justify an opinion, that the piers merely bore a relative proportion to the size of the arches. The equilibrium of arches has not been treated upon to any extent but by modern writers: yet, the construction of the dome of the Pantheon, at Rome, (Notre Dame de la Rotunda), seems to intimate an acquaintance on the part of the Roman architects with this branch of scientific knowledge, not to be discovered in any of their bridges—a curious fact, only paralleled in the instances of Gothic vaulting and Gothic bridges. The dome of the Pantheon, at its base, is considerably thicker than at the crown, thereby compensating for the enormous thrust exerted at its base. The relative proportions of the piers are instanced in the following among many old bridges:—

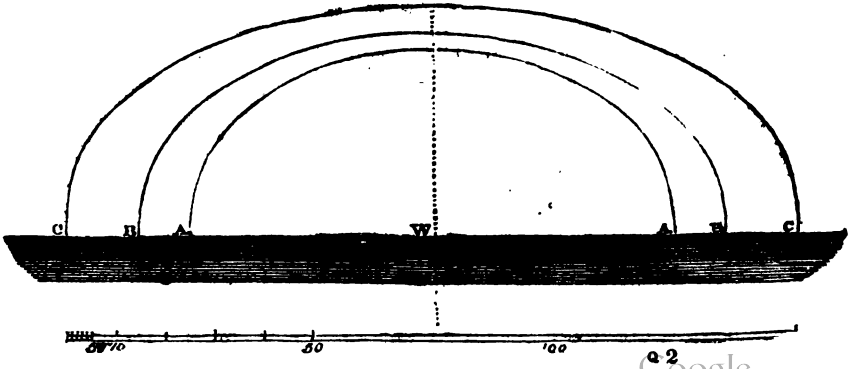
Bridge over the Loire at Saumur	$\frac{1}{4}$
Do. over the Illyssus at Athens	$\frac{5}{12}$
Do. over the Loire at Orleans	5·579
Do. at Rimini	$\frac{5}{12}$
Do. at Neuilly, by Perronet	
Do. over the Bacchiliogne at Vicenza, by Palladio	$\frac{1}{6}$
Do. over the Seine at Nantes	$\frac{1}{4}$ full.

Among the moderns we have,

The bridge over the Thames at Westminster	$\frac{1}{4}$ full.
Do. do. at Blackfriars	$\frac{1}{4}$ full.

This list might be extended much farther, but it is presumed these will be amply sufficient for the present purpose.

Fig. 2.



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On the proportions to be observed in piers, Messrs. Belidor and Gautier agree, namely, $\frac{1}{4}$ or $\frac{1}{5}$ at least. The former engineer has also given a highly valuable table for this purpose in his work "On Hydraulic Architecture." The table extends from arches of 20 feet to 100 feet span. As much controversy has taken place respecting the best and strongest forms for arches, and as the ellipse has been generally abandoned, fig. 2 will show at once the most successful applications of this curve.

				Feet.
AA, is the span of the centre arch,			Blackfriars	100
BB,	do.	do.	Waterloo	120
CC,	do.	do.	New London	150

The versed sines are taken from low-water mark. Experience has shown that, notwithstanding the repeated failures of the French architects, elliptical arches may and have been constructed of a span that twenty years ago would have created much alarm. New London Bridge exhibits the largest stone-arch in existence. I proceed to describe that structure (see fig. 1).

New London Bridge is situated about 200 feet west of the Old Bridge, and is built of Scottish, Peterhead, and Derbyshire granite, interspersed in various parts with Bramley, full, and other stone, according to the nature of the work. There are five elliptical arches, surmounted with a range of modillions or blocks, and the accompanying corona, above which is a close parapet or receding scamilli enclosing the road and path-way. At either end of the bridge are two flights of abutment-stairs. The several dimensions are as under:—

	Feet.
Length of the bridge within the abutments	782
Extent of abutments	74 each.
Span of centre arch	150
Versed sine of do. from high water	32
Span of side-arches next the centre	140
Versed sines of do.	30
Span of abutment-arches	130
Versed sines of do.	25
Thickness of piers of centre arch	24 each.
Do. of arches next the centre	22 each.
Width of bridge from outside to outside of parapet .	50
Width of carriage-way	33½

The farther consideration of this bridge shall occupy my next paper.

(To be continued.)

MR. JOPLING'S SEPTENARY SYSTEM.

Sir,—In the communication wherein I announced that I had reason to suppose that all the lines of the first division of the septenary system would be found to be epicycloids of the lines of the cusps, I did not give a plan of the planes in either the elliptic or hyperbolic cases. I beg, however, to offer now to the consideration of your readers, the plans of the planes in two other cases in the first division, which I think it is probable are as complicated as any other in the septenary system; but which, it will be seen, admit of as complete a classification and enumeration of the various characters of lines that may by those motions be produced as those of the more simple cases.

In fig. 1, AC and DB are two cranks of equal lengths, connecting AB, the distance between which is equal to the length of one crank with CD, the length of which is equal to the lengths of both cranks.

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Fig. 1.

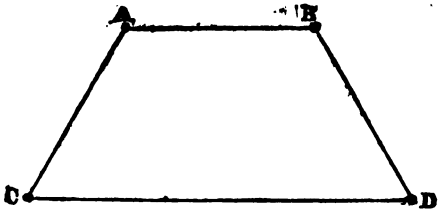


Fig. 2 is the representation of a plane supposed to be attached to, and its motion regulated by AB while CD is fixed. [This and some of the succeeding diagrams are drawn to a smaller scale than others, so as not to occupy unnecessary space in your pages.]

Fig. 2.

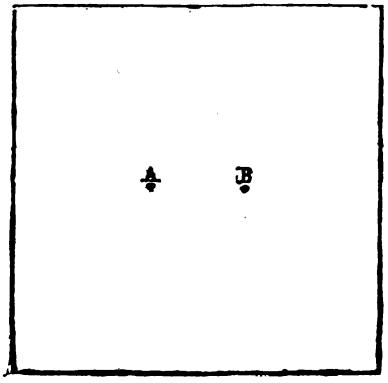
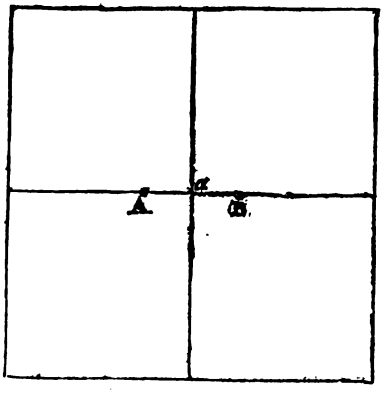
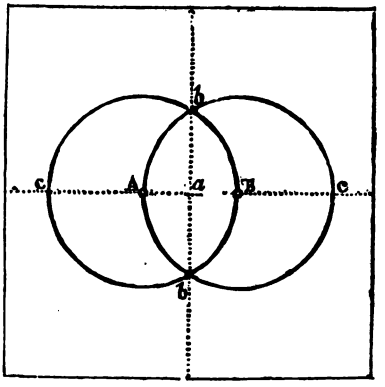


Fig. 3.



On this plane no visible lines of division or any particular points are to be seen, except the two poles A and B. But it has been found that the paths of all points upon a right line, drawn through the two poles, and those also upon another right line, perpendicular to the first, at a point midway between the poles (see fig. 3), are symmetrical figures, or such as may be divided into equal and similar parts. These lines are called the first and second infinite lines of symmetricals. These were the first and most obvious divisions which were discovered in this case; but they are not the only lines of symmetricals, for it has also been found that in this case, if two circles be drawn upon the plane (see fig. 4), the centres of which

Fig. 4.



being in the poles, and the radius equal to the distance between them, the path of any point upon each will also be a symmetrical line. These lines are called the finite lines of symmetricals. This plane is also farther divided by the lines of the cusps, one

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of which is represented by fig. 5. Both are shown by fig. 6; and fig. 7 shows the lines of the cusps with their tangents. The tangents, however, are not to be considered as division lines.

Fig. 5.

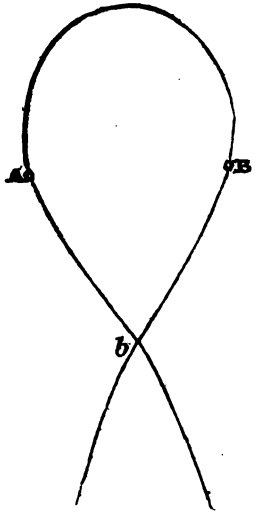

Fig. 6.

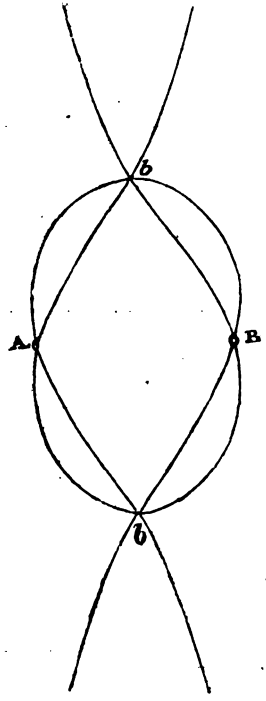

Fig. 7.

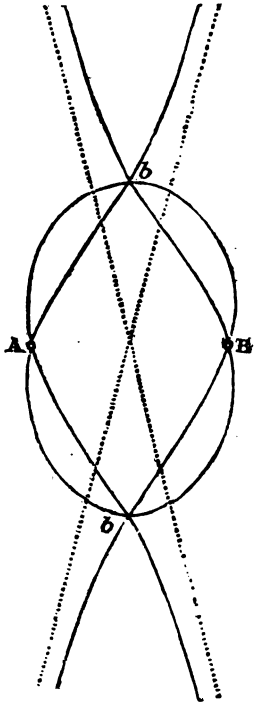

Fig. 8 exhibits a complete plan of the *infinite* and finite lines of symmetricals, and also of the lines of the cusps, with their tangents, upon a plane whose motion is thus regulated.

The path of the point *a*, at the intersection of the infinite lines of symmetricals, produces a sort of right lemniscate, or a line crossing its own path once, and forming a figure in four parts symmetrical.

The paths of the points *bb*, which is at the triple intersection formed by the two finite and one of the infinite lines of symmetricals, and also at the triple intersection formed by the lines of the cusps, are triangular figures with three cusps, and in six parts symmetricals.

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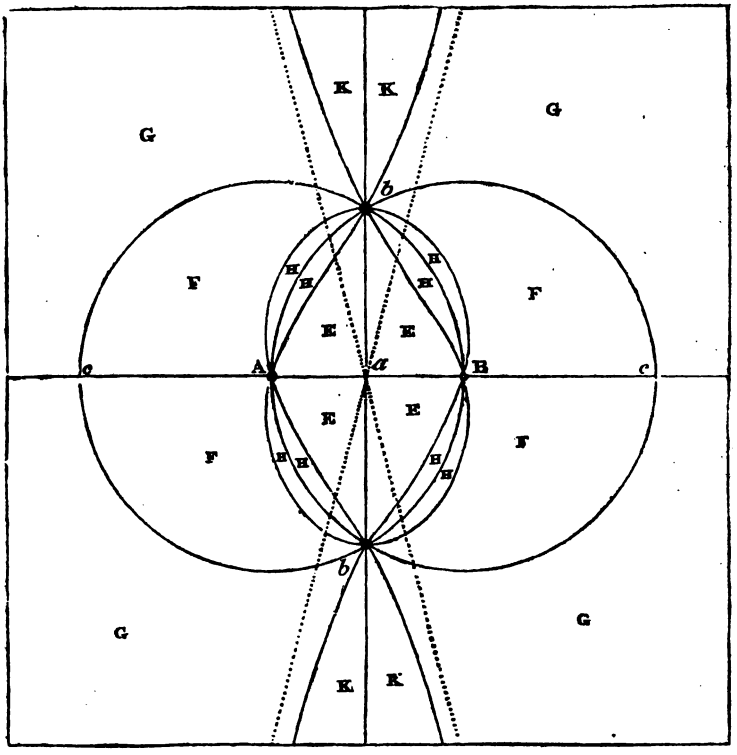
Fig 8.



The paths of A and B, the two poles, where the finite and one of the infinite lines of symmetricals intersect, and where the lines of the cusps also cross each other, are uniformly symmetrical lines (arcs of circles) each with two cusps.

The paths of the points *cc* are right lemniscates, in four parts symmetrical, and of exactly the same shape as that produced by the point *a*, but of double its dimensions. The points *cc* are at intersections formed by the finite and first infinite lines of symmetricals.

From *a* to *b* a series of points in a right line will produce a gradation between the first and minor right symmetrical lemniscate and the triangular figure. This is called the *first* series of symmetrical single nodated lines.

From *b* to *c* along the circle a gradation of symmetrical single nodated lines, between the triangular figure and the *major* right lemniscate, is obtained. This is called the *second* series of symmetrical single nodated lines.

Fig. 9.

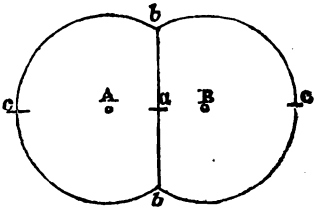


Fig. 9 is the figure formed by the points which produce single nodated symmetrical lines—the points marked *a b* and *c* only excepted. The first or minor series is twice produced by the right line; while the major or

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second series is produced four times by the arcs.

From *a* to A, or from *a* to B, the paths of a series of points in a right line will be a gradation of lines in two parts symmetrical, between the minor right symmetrical lemniscate, and the arc of a circle. This is the *first* finite series of oblique symmetrical lemniscates, or saddle curves.

From A to *c*, or B to *c*, between the arc and the major right symmetrical lemniscates, another gradation of *oblique* symmetrical lemniscates is obtained This is the second *finite* series of symmetrical saddle curves.

If from *c* or *c*, the points which produce the major right symmetrical lemniscates, the line of symmetricals be infinitely produced, points upon it will generate a gradation of lines between the major right symmetrical lemniscates and an infinite arc. This is the third and an *infinite* series of the symmetrical saddle curves. All the oblique symmetrical lemniscates are in two parts symmetrical.

From A to *b*, or B to *b*, along the circular arc (see fig. 4), the paths of a series of points will give a gradation of symmetrical double nodated figures between the arc of a circle and the cuspidated triangular figure. This is the first or finite series of symmetrical double nodated lines.

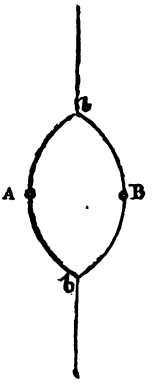
If the line of symmetricals *a b* be infinitely produced, points upon it, beyond *b*, will draw a gradation from the cuspidated triangular figure through symmetrical double nodated lines to an infinite arc. This is the infinite series of symmetrical double nodated lines.

The figure of the points which produce the symmetrical double nodes, is represented by fig. 10. The circular arcs, *b* A *b* and *b* B *b*, produce the finite series four times; the right lines proceeding from *b* and *b* produce the *infinite* series twice.

The *four* fields marked E surrounded by the lines of the cusps, and divided from each other by the lines of symmetricals, are the first finite fields of dis-symmetrical single nodated lines, or dis-symmetrical lemniscates.

The four fields marked F, having on the exterior a portion of the finite

Fig. 10.



lines of symmetricals, abutting upon the lines of the cusps, and each pair being divided by the infinite line of symmetricals passing through the poles, are the *second* finite fields of dis-symmetrical single nodated lines.

The four infinite fields marked G, abutting on the finite lines of symmetricals and on the infinite branches of the lines of the cusps, and each pair of fields being divided by the infinite line of symmetricals passing through the poles are the infinite fields of dis-symmetrical single nodated lines.

The *eight* fields marked H being surrounded by the lines of the cusps, and each pair divided by a portion of the finite lines of symmetricals, are the finite fields of dis-symmetrical double nodated lines.

And the *four* infinite fields marked K, contained between the infinite branches of the lines of the cusps, and each pair being divided by the line of infinite symmetricals, are the *infinite* fields of dis-symmetrical double nodated lines.

Thus it will be seen that this plane is divided into

Sixteen finite fields, and
Eight infinite fields; viz.

Eight { Four first and Foursecond } Finite fields of dis-symmetrical *single* nodated lines.

Eight—Finite fields of dis-symmetrical *double* nodated lines.

Four—Infinite fields of dis-symmetrical *single* nodated lines; and

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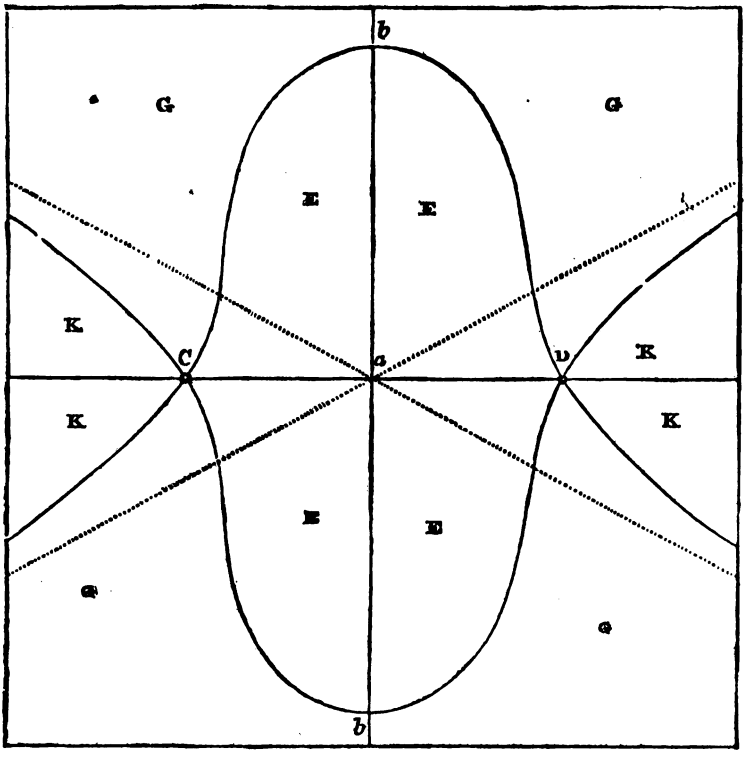
Fig. 11.



Four—Infinite fields of dis-symmetrical *double* nodated lines.

Having now given a minute, and I trust, comprehensive description of the first case, let it next be supposed that another plane is attached to, and its motion regulated by C D (see fig. 1), while the plane on A B is fixed. Fig. 11 will then represent the plan of the plane, with the lines of symmetricals and the lines of the cusps. The dotted right lines are the assymptotes of the lines of the cusps, which are the curved lines. The other right lines at right angles to each other, are the lines of symmetricals.

The path of the line described by the point *a*, which is at the intersection of the lines of symmetricals, is in four parts symmetrical; the form of it will perhaps be better understood by calling it a lemniscate. It differs, however, in its general appearance, from the lines called lemniscates in the former case, in having three double points, or crossing its own path three times, while the others only cross once.

From *a* to C, or *a* to D, a gradation is obtained between the triple crossing lemniscate and the arc of a circle, which each of the points C and D describe. All these lines are in two parts symmetrical, and with the exception of those produced by points very near *a*, which cross their path in three places, have but one double point. This is the first and finite series of these lines. A gradation of the *second* or infinite series of these lines is obtained by points upon the produced line of symmetricals beyond the poles C and D. This gradation will approximate to an infinite arc.

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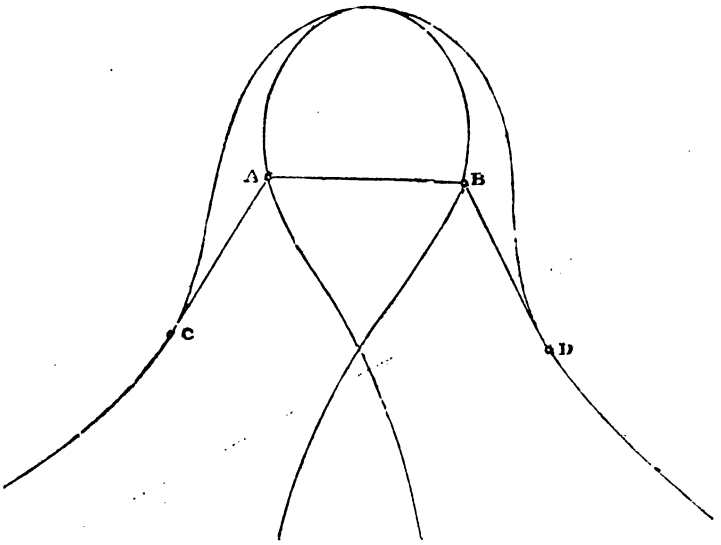
Fig. 12.



Proceeding from *a* on the other line of symmetricals to *b*, a gradation is obtained between the triple crossing lemniscate and a symmetrical single cuspidated figure; the cusp being exterior. Beyond *b* the gradation is through symmetrical oblate lines, approximating to an infinite arc. The points *b*, *b*, C and D, are on the lines of the cusps, and their paths have already been described to be symmetrical; but all other points upon those lines will draw dis-symmetrical *cuspidated* lines.

The four fields marked E produce dis-symmetrical *single* nodated lines, with the exception of a small portion of each field approaching *a*, where the describing point crosses its own path thrice. These fields are called the *finite* fields of dis-symmetrical nodated lines.

The four fields marked K are the *infinite* fields of dis-symmetrical nodated lines.

The four fields marked G are *infinite* fields of dis-symmetrical oblate lines.

In this case there is no finite field of oblate lines.

In both this and the former case the number of *infinite* fields are *eight*. In the former case the number of *finite* fields were sixteen, or *double* the number of the infinite. In this case there are four finite fields, or *half* the number of the infinite.

Having given so particular a description of the first case, it is supposed what has now been given will be sufficient to make this case understood.

In fig. 12, a line of the cusps in each case is represented in connexion with the double cranks, in order to show that if the line of the cusps in the first case be attached to AB while CD is at rest, it will roll within the line of the cusps in the second case. And if CD be in motion and AB at rest, the line of the cusps in the second case will roll upon the line of the cusps in the first case. But the whole of the lines described by these motions of the double cranks could only be produced by the epicycloidal motions of both pairs of the lines of the cusps and those infinitely extended. Although the lines of the cusps in these cases are infinite, their epicycloids are, as in the case of the hyperbolas, finite lines. Indeed, a regular gradation may be shown to exist between these lines of the cusps and the hyperbolas, from

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which the nature of them may probably be ascertained. It may be worthy of remark, that the epicycloids of both the hyperbola and parabola, as well as of these lines, may be generated with greater facility than the parabolas and hyperbolas themselves. By the cissoidal and conchoidal principle, the epicycloids of the parabolas are easily drawn, and nothing can exceed the facility and accuracy with which the double cranks will describe vast numbers of the most beautiful epicycloids.

I am not aware of any study more eminently calculated to lead the mind so constantly from the finite to the infinite, as such inquiries as these; or where the possibility of an intimate relation between such extremes is so obviously, and, in such a variety of ways, so beautifully displayed. I have, however, to regret that I have not now a better prospect of publishing a complete illustration of the septenary system than I had seven or even eight years ago.

In conclusion I beg to say, I shall esteem it a particular favour if any of your correspondents can suggest any amendment either in the terms employed, in the order of gradations, or in the several descriptions which have now been given in your pages of different parts of the septenary system.

I am, Sir,
Your obedient servant,
JOSEPH JOPLING.

EXPERIMENT WITH A LOW-PRESSURE BOILER ON MESSRS. BRAITHWAITE AND ERICSSON'S EXHAUSTING PRINCIPLE.

(From the Liverpool Albion of the 31st of May.)

We have received the following highly interesting account of the experiments made, on Saturday, with a new marine boiler, on Messrs. Braithwaite and Ericsson's construction. It is a low-pressure boiler; and, from these experiments, it is evident that the following important advantages will arise to steam navigation by the introduction of this principle:—

1. The total absence of all smoke.
2. The dispensing with the chimney.
3. A saving, at least, 120 per cent. in the cost of fuel, and 30 per cent. in the space to stow it.
4. A saving of about 400 per cent. in the space occupied by the boilers.

We have neither room nor time to make any farther remarks on this important discovery, but hope to be able to furnish our readers, next week, with additional particulars and experiments. The same principle is now applying, by Messrs. Braithwaite and Ericsson, to the new locomotive-engines, constructing for the Liverpool and Manchester Railway, which are to be delivered at Midsummer, and a similar combination of vast power in a small space, with a great saving of fuel, will be applied to them.

Memoranda relative to the Experiments made at Mr. Laird's works, at North Birkenhead, with the new Low-pressure Boiler on the Exhausting Principle of Messrs. Braithwaite and Ericsson, by Alexander Nimmo, C. E., Dublin, and Charles B. Vignoles, C. E., London.

In the course of these experiments the following gentlemen of Liverpool were present; viz. Messrs. John Ashton Yates, Hardman Earle, John Cropper, Samuel Parkes, John Chapman, Joseph King, George Forrester, C. Horsfall, jun., John Laird, M'Gregor Laird, and several other gentlemen, four of Mr. Vignoles' assistants attending to the weights and measurements, and Captain Ericsson's engineer, Mr. Keating, and Mr. Sorringen, a Norwegian engineer.

The exhausting apparatus consisted of a fan-wheel, with broad radial leaves, revolving within a close box or chamber, placed a little apart from the boiler, but connected with it by a passage leading from the flues traversing the boiler; a short tube above the exhausting chamber passed out to the atmosphere.

The furnace was attached to and placed at the end of the boiler, opposite to the exhausting apparatus, which latter being put to work, drew through all the turns of the boiler the hot air from the fire, which passed over the throat of the furnace through the bridge flue, and then successively through the other five turns of the flue arranged through the boiler, and finally was drawn through the exhausting chamber and passed into the atmosphere.

The heat, which in the furnace was extremely intense, was absorbed by

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the water in the boiler as the air rushed through the flues, and, when passing up the tube or funnel from the exhausting chamber, was so far cooled that the hand and arm might be placed with impunity down the tube, the temperature probably not exceeding 180° of Fahrenheit. Not the slightest smoke was perceptible.

The following are the principal dimensions measured :—

	Ft.	In.			Ft.	In.	
Furnace	2	0	deep	Ash Pit	1	0	deep
	2	6	long		2	6	long
	2	6	wide		2	6	wide

The openings of the fire-bars equal to about half the area of the bottom.

	Ft.	In.			Ft.	In.
Exhausting Chamber.	2	6	high	Outside Dimensions	Diameter of Exhausting-wheel	3 0
	3	6	wide		Breadth of the same	0 10
	3	6	long			

Bridge flue or throat from the furnace 2ft. 6in. broad, 4in. wide, 2ft. deep, 5-16in. iron plate.

First turn of the flue, 4in. wide, 2ft. deep
2nd, 3rd, 4th, and 5th turns, 3in. wide, 2ft. deep } ¼in. iron plates.

Whole length of the flues through the boiler..... 45 feet.

Superficial area of the heating surface .....247 square feet.

The contents of the water in the boiler when filled were from..... 85 to 90 cubic feet.

The superficial area of the evaporating surface in the boiler ..... 33 square feet

The proportion of the heating to the evaporating surface nearly..... ..... 7½ to 1

Steam Chamber { 3ft. wide, 4ft. 10in. average depth, 4ft. 6in. long } Containing about 65 cubic feet.

Diameter of the safety valve very nearly 5 inches, being 19 square inches area, which was loaded for a pressure on the square inch of 4lbs.

Giving 76 for the load.

Of this, 66lbs. of iron were placed in the boiler, and 10lbs. allowed as the weight of the valve, rod, hook, handle, &c.

The water used was the salt-water from Wallasey Pool, and filled into a large iron tank, the area of the surface of which measured 32½ superficial feet.

The boiler was placed under an open shed: the day was very cold, with thick rain. No engine being attached to the boiler, the exhausting apparatus was worked by a wheel and band from Mr. Laird's turning engine. The velocity of the circle of percussion of the leaves of the exhausting wheel was determined to be about 77 feet per second, or upwards of 52 miles an hour. Mr. Laird's engine is stated to be a four-horse power. No determinate measurement was made, but the engineers present computed, that the power applied to turn the exhausting wheel was equal to that of two horses.

The fire being lighted, the steam was got up to 4lbs. pressure in 45 minutes, with a consumption of 2½ cwt. of coke. The expenditure at first was 8lbs. per minute, and gradually decreased to 5lbs.; averaging about 6½lbs. per minute for getting up the steam. The steam began to rise in 27 minutes, after which the consumption of coke was little more than 5lbs. per minute; and at this period there would have been a sufficient supply of steam to work the cylinders of an engine.

The coke employed was gas coke of very bad quality, of which 3½ cubic feet weighed 105lbs., giving 30lbs. for the weight of a cubic foot, or 3000lbs. as the weight of 100 cubic feet. The same weight of St. Helen's coal (that principally used in steam-boats) measures 63 cubic feet. The cost of the coke used was 8*s.* 6*d.* per ton, delivered in Liverpool; the cost of smithy coke being 25*s.* per ton, of which 3½ cubic feet weighs 115lbs., giving very nearly 33lbs. for the weight of a cubic foot.

When the steam was up, the water in the thick glass gauge attached to the boiler standing at 7½ inches, the two men stationed for the purpose began to pump, a fresh supply of weighed fuel was placed on the floor, and the following observations were made :—

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At 3h. 32m. began to pump.
At 3h. 54m. 16 cubic feet of water were evaporated.
At 4h. 12m. 27 cubic feet of water were evaporated.
At 4h. 19m. 38 cubic feet of water were evaporated,
And 2 cwt. of coke consumed.
At 4h. 32m. 41¼ cubic feet of water were evaporated.
With a consumption of 252lbs. coke.

From which it appears, that only 6lbs. of coke per cubic foot of water per hour was consumed, and the evaporation of a cubic foot of water per hour being generally considered the measure of a horse power, the conclusion is, that the boiler was a forty-horse boiler, and that the quantity of fuel requisite to work it is 2¼ cwt. per hour, the expense of which is 12¾*d.*; and as the consumption diminishes after the first hour, the expense of fuel will probably not exceed 1*s.* per hour for the forty-horse boiler

(Signed)
ALEXANDER NIMMO, C.E.
CHARLES B. VIGNOLES, C.E.

Waterloo Hotel, Liverpool, May 29, 1830.

REDUCTION IN THE COST OF PRINTING APPARATUS.

[*From the "British Co-operator," No.* 3, *into which the article appears to have been copied from the American "Free Enquirer."*]

It is well known, by those who have considered the subject, that printing is a power that governs the destinies of mankind: and, therefore, those who can control the printing-press can control their fellow-creatures.

While men continue the practice of interfering with the persons and property of each other, it is to be expected that each in his own defence will make use of all the means within his control to increase his own power, and to diminish that of others.

At this time, 1830, the means of printing are so expensive, that the great mass of the people are almost totally deprived of their use—while the wealthy few (by their capital, or influence) wield this mighty engine, to increase their own power, and to weaken that of others: and while the *ignorance* of mankind shall permit them to disregard the happiness of each other, and to limit their mutual encroachments, only by their power, it appears that the *equality of power* will be the only guarantee for the enjoyment of equal rights.

The fundamental importance of these considerations, induces the subscriber to make known, in the most effectual manner, the results of a series of experiments, instituted with the hope of bringing the printing-press *equally* within the reach of *all.*

Preparations for casting types have been made with the expense of about twenty days' labour, with the use of white-smiths' tools, and about five dollars in money. In this department, labour and money expenses have been diminished, in many particulars; the most important of which is, the substituting matrices of lead—stamped with types—instead of matrices of copper, stamped with steel punches; whereby the difficult and expensive business of cutting steel punches is avoided, and the casting of types, which is now monopolised by monied capital, can be effected by almost any person of common intelligence, without apprenticeship, and without dependence on capitalists.

A printing-press has been constructed of a stone platform, and a roller of sufficient weight to give the impression, supported at the ends, by bearers which keep it at a proper height above the types, to admit the paper and clothing between. The necessary cost of this press is about five days simple labour; while it requires an experienced workman to make the common press, and it costs from two to three hundred dollars.

Labour and expense have been diminished in other particulars, which cannot easily be described here. It may suffice to say, that the materials employed in this communication, can be manufactured for about twenty-five dollars—twice this size, for about thirty-five, and in a smaller proportion as the size increases; while the common printing establishments cost from

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about four hundred to two thousand dollars.

The existence of an absurd custom (giving the power of monopoly by patents) renders it necessary to state, that any person is at liberty to make use of these simple, yet important, improvements; and any additional information will be freely given.

Preparations are now making to supply those who prefer to purchase these materials, rather than make them. They will be manufactured and sold upon the principle of labour for labour, of which notice will be given through the medium of "*The Free Enquirer*," a paper devoted to the great interests of mankind—conducted in New York by Frances Wright, and R. D. Owen.

It may be useful to inform those who are unacquainted with the fact, that the art of using types may be acquired by females or children in a few hours.

N.B.—All communications (for obvious reasons) must be post paid.

JOSIAH WARREN.

Cincinnati, Jan. 30, 1830.

ON THE FORCE NECESSARY TO SECURE HIGH-PRESSURE STEAM.

Sir,—I do not intend to interfere in the controversy between Mr. Gilman and his opponents, for I think that a statement, an answer, a reply, and a rejoinder, is a sufficient latitude to be allowed for any discussion, and quite enough to exhaust the subject of any thing which is calculated either to interest or instruct.* But a point in practical mechanics has been incidentally adverted to, which, from its being of some importance, ought not to be dismissed without a separate, and now extended, inquiry. "A Practical Engineer," in his observations addressed to "S. Y.," in No. 351, asserts, that to secure steam of 300lbs. on the square inch, the force with which the bolts press the cover and bottom into contact with Mr. Gilman's generator, must be more than quadruple the same pressure per square inch on the area of the generator. It is a prudent maxim in these cases to be stronger than strong enough, and if the mooted point referred to *surplus* strength, I should not be disposed to question the accuracy of this statement of the Practical Engineer; but I understand him to say, that this excess of the force of contact over the pressure is absolutely necessary, in order to secure a sound joint. Now, it is evident that an equality only of these forces is requisite, according to that simple theory of the case which excludes all contingencies, and supposes all the parts to be perfect. In practice, however, the force with which the surfaces are in contact, must be considerably superior to the separating force, but to what extent, experiment only can determine. "A Practical Engineer," says, that it must be more than quadruple, while my experience, and some experiments on the subject, lead me to think that even a double force is unnecessary; and when more is required, that it must arise from a mismanagement of the bolts, an unskilful construction of the joints, or imperfect workmanship in their execution. It may excite surprise with some, that a sound joint should require the surfaces to be in contact with a force any more than just superior to the pressure to be counteracted, since the lesser cannot overcome the greater; and the question may be asked, in reference to a vessel in which the internal pressure should be gradually increased until the bolts gave way, whether, at the moment before, when the joint *was sound*, the tension of the bolts could have been *greatly* superior to the force which was acting to extend them. Paradoxical as it may appear, I have no hesitation in saying, that possibly it might; but I should prefer seeing the explanation of the difficulty which this view of the subject presents, from the "Practical Engineer," "S. Y.," or some other of your ingenious correspondents.

One of the experiments alluded to above, was this—a vessel of six inches diameter was subjected to a water pressure, equivalent to that of 200

* If in a discussion like the Harrison controversy, *fresh* matter is continually elicited, in regard to the minutiæ and details of practice, its length is not hastily to be complained of, because on these points our books of reference are exceedingly deficient. I beg Mr. Editor's pardon for obtruding these ex-officio-like remarks.

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atmospheres; but at this point thirteen out of the fourteen bolts gave way. Eight or nine were broken, and the others so stretched as to be useless. The area of fracture was four-tenths of an inch in diameter. From these data it is easy to calculate that the strain on the bolts was equal to more than twenty tons on the square inch. The very best iron will not sustain more than thirty tons on this area. Now, the tension of the bolts, or the form with which the surfaces were brought in contact, could not, of course, have been carried in the act of screwing up, to the extent of this, their breaking point; probably not to more than twenty-six, or twenty-eight tons on the inch. But it is in proof that they did not fail, or allow the vessel to leak, when the strain was equal to twenty tons on the inch. Consequently, the force of contact, instead of being quadruple that of the pressure, was superior to it only in a very inconsiderable degree. I need not add that the joint was a good one, and that some care was taken in the management of it. There is no doubt that by an unskilful mode of proceeding the bolts may be broken with one-half or one-third of this pressure. As the result of this experiment is utterly at variance with the experience of "A Practical Engineer," I deem it proper to subjoin my name, in order to authenticate that it is no "*chimera*." It may appear astonishing that the bolts should have broken, and not have extended a little, so as to allow the vessel to leak, and be relieved from the pressure; but such was the fact, and it is not difficult to find an explanation.

Mr. Gilman should state more explicitly who is the inventor of that mode which he adopted, of making a joint by means of a copper wire, for I have heard it ascribed to Dr. Alban.

I am, Sir,
Yours, &c.
BENJAMIN CHEVERTON.

P.S.—Since writing the above, I have seen the communication of "A Practical Engineer," in No. 354, from which it appears, that his assertion of the superior force necessary to secure high-pressure steam, is not intended to apply generally; but whether it is limited to the double-joints of Mr. Gilman's generator, or to vessels of two feet and upwards in diameter, is not very apparent. I shall merely observe, that unless the cover of the vessel is supposed to be of sufficient strength to withstand, under the given pressure, the spring of the metal at any part of the joint, it were an idle and random remark to state any *degree* of force superior to the pressure, as necessary to prevent a leakage, for this could not be avoided under such circumstances with any force whatever. With the necessary conditions of proportionate strength, I cannot perceive any difference in respect to the joints, between large and small vessels; nevertheless, I shall be happy to be farther and better instructed from the experience which "A Practical Engineer" has acquired.

MINOR CORRESPONDENCE.

Omicron's Question.—Answer to Tempora, vol. xiii. p. 283.—"It is demonstrated by writers on trigonometry, that the perpendicular of any right-angled triangle divided by its hypothenuse, is equal to the sine of its angle at the base. Now, $\frac{2}{1000000 \cdot 000001} = 0{\cdot}000002$, extremely near the truth. Hence as the sine of 1″, or as ·000004848137 : 1″ :: ·000002 : 0″·41253 the angle as required."—J. UTTING, *Lynn Regis*.

Dr. Birkbeck.—"You seem to lay immense stress upon no denial written or otherwise having reached your ears as being made by Dr. Birkbeck in answer to the calumny that was insinuated against him. Now, I beg to inform you, that the "indignation" with which you allow Dr. Birkbeck repelled the charge, *was* "justified" by two solemn denials—just such as you might wish—the one written, the other verbal; and both given before several hundreds of persons."—H. B. J. [Our correspondent has omitted to state what it was Dr. Birkbeck denied. Was it the fact of his representing the Institution in November last to be in a flourishing state, when it was deplorably the reverse? Or that other equally-memorable fact of his having received all the money which was derived from the appropriation of the theatre to improper uses? H. B. J. adds some statements with respect to the origin of the loan and early history of the Institution, which we do not insert, because we know them to be altogether erroneous.]

Water at Streatham.—"You are probably aware that in this neighbourhood great inconvenience is felt from the want of water, and that generally the only supply is by carts, in which it is conveyed to the several houses from a considerable distance, and consequently becomes an expensive article. Many persons have been at great expense in digging wells without success.

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I have heard of one person only who has obtained water, who for some time allowed his less fortunate neighbours access to his pump to fill the water-carts; but finding the continual operation and presence of the carts, &c. &c. to be a nuisance on his premises, such permission is withdrawn. My object in addressing you is to ascertain if it is practicable for me to avail myself of an offer kindly made to me of introducing a suction pipe into the said well, to be connected with a pump on my own premises, which are at the distance of 300 yards from the well, and, if practicable, the best mode and description of pump for doing so. I should state that the water in the well rises to 19 feet from the surface of the ground, and by pumping is lowered not more than 3 feet; my premises are about level with the top of the well. My plumber tells me there is not any difficulty, provided the water is within 32 feet in height from the pump-barrel, and that the distance of 300 yards is of *no importance whatever;* of this I have some doubt, and shall, together with many neighbours, feel much obliged by the opinion of any practical correspondent on the subject."—W. R, *Streatham, May* 8, 1830.

[We recommend our correspondent to set his plumber to work immediately; there can be no doubt about the practicability of the thing.—Ed. M. M.]

Ogle's Air-Machine.—"After more than once slightly perusing the account of Mr. H. Ogle's air-machine, in your 12th volume, page 114, without understanding it—thinking it very odd, but supposing it true, as it had the sanction of efficiency from "learned gentlemen and mechanics." I, this day, set resolutely to work to endeavour to comprehend its powers of action, which, in my opinion, are nothing—if my ability to understand it be any thing. Mr. Ogle seems to assume two first movers or separate motive powers, namely, a horse and *suction*. A horse "lifts the bellows, and the bellows suck the air out of the bottom of the cylinder, and the piston comes down:" but "suction" is no power, and I believe the horse would pull down the piston as well without the bellows as with them—and better, because of less friction. Mr. Editor, is not as much horse-power spent in "sucking," or endeavouring to produce a vacuum or expansion, as there is atmospheric power exerted to refill that vacuum? if so, the machine is nothing but lumber."—Saxula, *May* 10, 1830.

M'Duff's Buhl-Cutting Machine.—"In No. 351 is an engraving and description of the buhl-cutting machine of Mr. M'Duff, which Mr. Brougham particularly noticed for its simplicity. There is, however, a superfluity of means employed, which is very obvious. The wheel *g*, the pulley *t*, the hollow cylinder of wood *h*, with the spiral spring which it contains, may all be dispensed with, by introducing a connecting-rod from a crank on the spindle *p* to the saw-frame *d*. The artisan should learn, that however pretty and ingenious it may be, the circuitous mode of effecting an object should always be rejected in favour of the direct and obvious method, however common-place it may appear. But this, like the art of blotting in literary composition, is a difficult task to learn. Ingenuity in invention, as well as imagination in poetry, ought to be under the correction of a severe taste, else its exuberancies will mar the whole."—B. C.

Camera Lucida.—"Will H. G. have the goodness to try his camera lucida with a two foot rule, and say whether the divisions of inches, as traced on the paper, are equal throughout the whole extent of the scale—the extent of the variation, if any—and whether it increases as the sizes of the delineation is enlarged?"—B. C.

MISCELLANEOUS.

Safety-Lock.—We have been favoured with an inspection of a new safety or protector-lock, apparently of great merit. It has been declared that, however complicated may be the wards or interior of a lock, it cannot be called perfectly secure from an ingenious artist. The inventor of this new lock therefore proposes to guard the key-hole, so that any attempt to force or pick the lock, must of necessity be discovered. For this purpose a small box or chamber, with a lid similar to a snuff-box, is affixed over the front of the lock, with a key-hole corresponding in size with that of the lock. The lid of this chamber being open, the bolt is turned, and the key withdrawn in the usual way; after which a small paper label is laid over the key-hole, and the spring-cover shut down, so as to prevent any possibility of its removal except by violence. The person having the key can thus, in all cases, see, before he again opens the lock, whether any attempt has been made to open it during his absence. It is the invention of a Mr. Gottlieb, who holds an appointment in the Excise-Office.—*Literary Gazette.*

Boat propelled by Horses.—The *Court Journal* gives the following account of a vessel of a new construction which has been recently launched on the Lago di Garda:—"M. de Riva has brought to perfection a machine constructed partly of cast and partly of wrought-iron, which is set in motion by eight horses, and drives two paddle-wheels in the same way as if steam had been applied. It is also capable of giving the wheels a retrograde motion, and raises and depresses the wheels as occasion requires; by which last operation their occasionally excessive dip into the water, which derogates from their power, is remedied. This machine has been fitted up in a vessel, calculated to receive a cargo of 100 tons weight; and she has made several trips with the most satisfactory results. The company who have brought this plan to bear, have baptized the vessel by the name of 'L'Amico alla prova,' the proved friend."

INTERIM NOTICES.

The Spirit of Literature will be published in Monthly Parts, as well as Numbers, every Magazine-Day. Part I. on the 1st of July. We have to thank a "Well-wisher" for pointing out the omission of this feature of the publication in our previous announcements.

"One of our oldest Contributors" has hit upon what we believe to be a new discovery—that is, if we understand him rightly. His description is, however, very obscure.

"A Subscriber nearly from the commencement" will find the information he wants in No. 352.

Communications received from J. W.—G. S.—S. C. J.—Mr. John Linley—Mr. J. Tomson—L.—S. Y.—Mr. Baddeley—Mr. Utting.

The number of Engravings in this Number has caused the exclusion of one or two articles which were promised a place this week. They shall certainly appear in our next.

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M. SALMON, Printer, Fleet Street.

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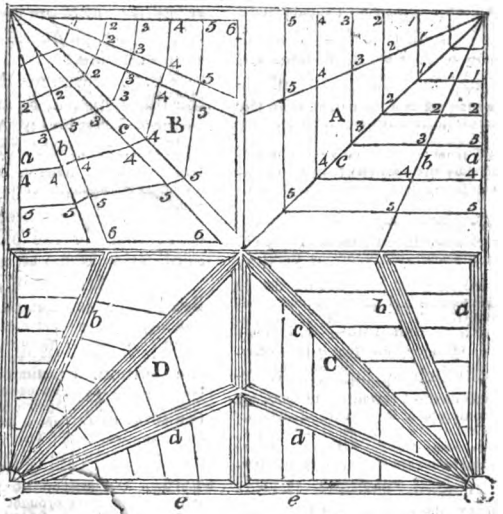
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 357.] SATURDAY, JUNE 12, 1830. [Price 3d.

MR. JOPLING'S IMPROVEMENTS IN RIBBED GROINS.

Fig. 1.



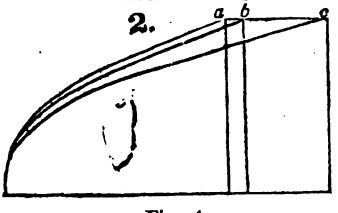


Fig. 4.

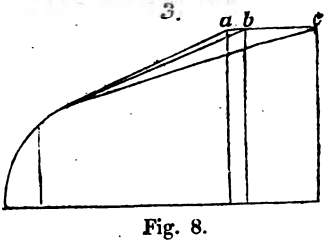
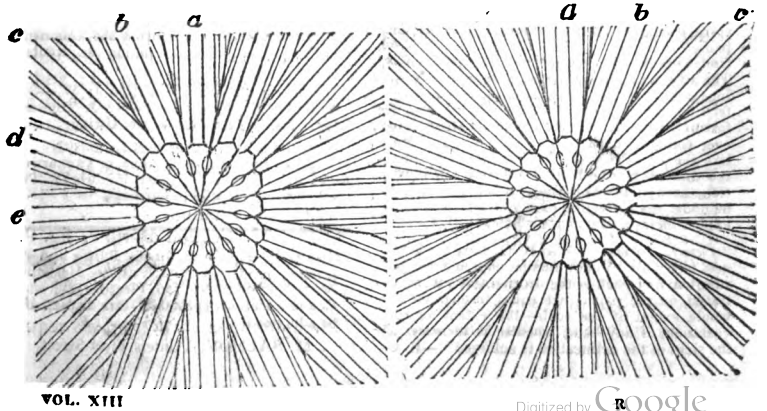


Fig. 8.



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OBSERVATIONS ON RIBBED GROINS. BY MR. JOPLING.

(Communicated to the Society of Arts.)

Having observed that much difficulty is experienced in executing ribbed groins in plaster, and that the work is done in a very incorrect manner; and having heard that others have made the same observation, I am induced to offer a few observations, drawings, and models, which, I conceive, may be the means of reducing the expense and improving the appearance of works of this nature.

The desirable object is, to form the surfaces of groins, so that the curvatures of the various ribs may be without cripples, that they may intersect truly, also stand perpendicularly over their respective plans, and that they may be executed by the usual mode of running plaster mouldings.

In the early examples of ribbed groins, few, if any, of the ribs intersect truly at their springing. Whether this occurred through design, or from not knowing the principles of intersection, may be doubtful. If it was intended to imitate the spreading-branches of trees, perhaps it was thought more natural for some of the ribs to rise behind others, than that they should intersect truly; yet, as we see other intersections hidden with foliage, it would appear that their not intersecting truly was considered a defect: for instances occur, where the intersections, being correct, there is no foliage; and, in the same groin where the intersections are not true, foliage is added. Those persons who introduced ribbed groins of the same curvature, it is probable, had discovered, that ribs must be of like curvature, to intersect truly at their springing; and, that ribs of merely like sections would not do so. It is therefore likely, that their object, in introducing them, was to have the intersections true. They might also wish to save the trouble of determining the form of separate ribs, by the slow geometrical process of ordinates. However, the time required to determine the forms of the ribs, is not an object when compared with the time required to execute them.

The following definitions will exhibit at once the source of the errors hitherto in practice, and the principles of the mode here recommended, in order to avoid those errors.

Fig. 1, exhibits the plan of a square groin. At A, the corresponding numbers represent the old method of corresponding points of height in the different ribs. At B, the corresponding numbers represent the corresponding points of height by the proposed plan.

Fig. 2, represents the curvatures of the three ribs, *a*, *b*, and *c*, according to the old method at A, fig. 1.

Fig. 3, represents the curvatures of the ribs, *a*, *b*, and *c*, according to the proposed method at B, fig. 1.

Fig. 4. Plan of intersections of ribs, calculated for the old method; this application is shown at C, fig. 1.

Fig. 5. Section of *a*, or given rib, fig. 4; the section of rib *e*, fig. 4, is the same.

Fig. 6. Section of rib *b*, fig. 4, at the bottom, or springing. This rib must vary from the form of fig. 6, to the form of fig. 5. The rib *d* will be its reverse. These cannot be executed by a running mould.

Fig. 7. Section of rib C, fig. 4, at the bottom, or springing. This rib must vary from the form of fig. 7, to the form of fig. 5. This cannot be executed by a running-mould.

Fig. 8. Plan of intersections of ribs, calculated for the proposed method. The application is shown, at D, fig. 1. By the usual method of running plaster mouldings, the whole of the ribs, *a*, *b*, *c*, *d*, and *e*, may be executed.

Fig. 9. Plan of intersections meeting in a common point, and showing the two methods, when the ribs are more crowded in one place than another; the application of the old method is shown at A, fig. 15; and the application of the new method at B, fig. 15. The new method may be executed with one mould.

Fig. 10. Section of rib *b*, fig. 9, at the bottom, or springing, as required by the old method.

Fig. 11. Section of rib *c*, fig. 9, at the bottom, or springing, as required by the old method.

Fig. 12. Section of rib *d*, fig. 9, at the bottom, or springing, as required

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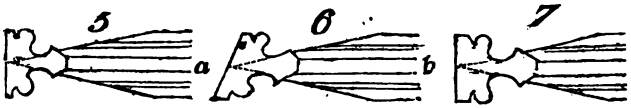

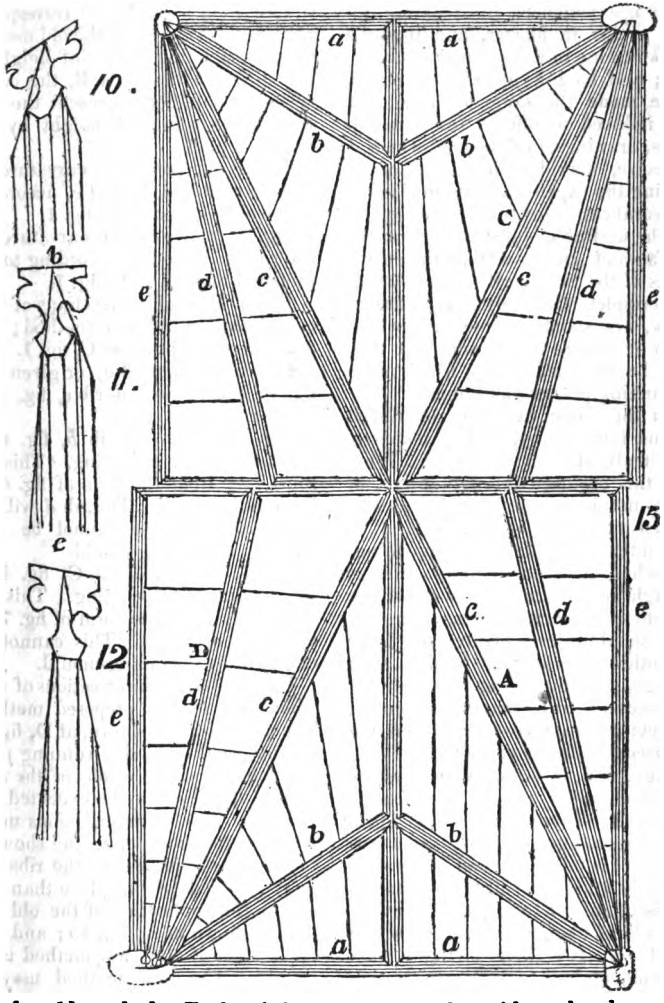

by the old method. Each of these last ribs must vary from their respective forms to that of the rib *a*, fig. 5, or they will not intersect with the ribs *a*, or *e*, or with each other. None of the ribs *b*, *c*, or *d*, as applied at A, fig. 15, can be executed by the usual mode of running plaster mouldings.

Fig. 13 shows, how ribs making the same angles with each other, as in fig. 9, may stand at their springing, so as not to be more crowded in one place than another; their application is shown at C, fig. 15: these may be executed with one mould.

Fig. 14 shows, how ribs making the same angles with each other as in the last and fig. 9, may stand so that the height of all the intersections may be

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alike; these may be executed with one mould: this application is shown at D, fig. 15.

Fig. 9.

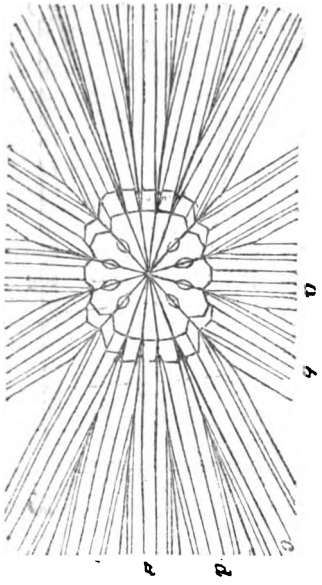
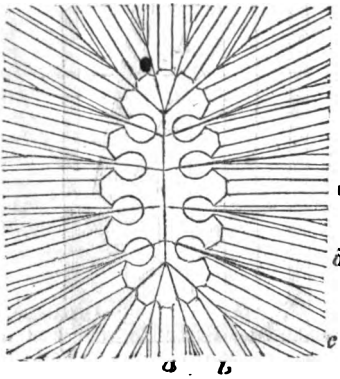


Fig. 14.



REPLY OF "S. Y." TO "A PRACTICAL ENGINEER."

Sir,—I defy "A Practical Engineer" to refer to any remark of mine from which it may be fairly inferred I meant to intimate there was a difference between Mr. Gilman's joints being made *without turning* and their being made without *being turned*. What I said implied there was a wide difference between the question *I asked* and the question *he answered*; and knowing what I said was true, he thought he could not do better than *wilfully misrepresent what I did say*, which he has accordingly done, p. 187.

Mr. "Practical" says, in No. 350, in a very supercilious tone, "I can tell him ("S. Y.") that double, treble, and *quadruple* that pressure will not be sufficient." I asked him WHY? and in No. 354, he all but acknowledges *he does not know*, but partly repeats the assertion, and says, that "double or *even* treble the weight will not be sufficient:" but he does not tell us whether "quadruple" will or not. He farther says, "as I speak from practice, I am not to be baffled by a theoretical or speculative opinion." This is equivalent to saying, "The thing is so *because I know it is so*: but I cannot or I will not give any reason why it is so." He is "inclined to think a much less weight would be sufficient if equally distributed over the whole of the cover, than would be found to answer if placed at the edges." This is truly admirable! It reminds me of a tract, published by a celebrated society, wherein it was stated that *the same quantity of water weighed more in a long bottle than when put into a short one*. But Mr. "Practical" may depend upon it *I* am not to be "baffled" by such statements as these, although he may "speak from practice;" and I "challenge him to prove by *competent witnesses*" that he ever saw a joint *properly* made in the way described by Mr. Gilman, or similarly, that was not kept tight by bolts of *double* the strength spoken of. "*This I shall always consider as the test to which I put Mr. 'Practical.'*"

Mr. Gilman says, No. 344, p. 29, "the aggregate sectional area of these 12 bolts is equal to (supporting) 260 tons, before even any elongation could take place, according to the experiments of Captain Brown and others." If we divide 260 by the number of tons which Captain Brown has proved by experiment a square

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inch of iron will bear "without elongation," the result will give the area at once, "as given by Mr. Gilman." I, however, thought he had given their area in inches, and am so far mistaken.

I must beg for room to assure "Peter Pindar," that I neither meant to "sneer" at nor draw any comparison between myself and him, or his "many others;" but simply to say we had no right to respect their opinions until we knew they are qualified to give one on better grounds than "Peter Pindar's" assurances.

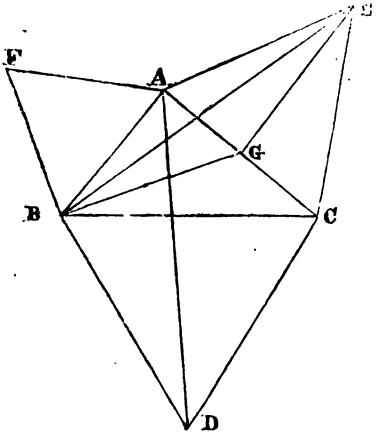
I am, Sir,
Yours, &c.
S. Y. (An Engineer.)

May 22, 1830.

SOLUTIONS OF THE FIRST NEW MATHEMATICAL QUESTION, P. 7, VOL. XIII.

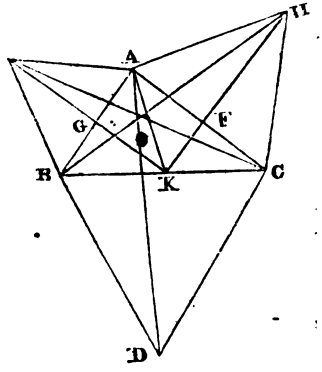
QUESTION.—*Prove from principles contained in the first book of Euclid, that the equilateral triangle described upon the hypothenuse of a right angled triangle is equal to the two equilateral triangles described upon the other two sides.*

By George Webb, Pupil, Mansion-House School, Hammersmith.



Let ABC be the right angled triangle, right angled at A, and upon the three sides describe the equilateral triangles BCD, ACE, and ABF; then shall the equilateral triangle BDC be equal to the two ACE and ABF. Bisect AC in G, join BG, EG, BE, and AD, then the angle EGA is a right angle also, BAC being a right angle ∴ BA is parallel to EG, hence the triangle AEG = EBG; add to each the quadrilateral BGEC, then will the triangle BCE be equal to the two triangles AEC and BGC, or equal to AEC, and half the triangle ABC. Again, by adding the angle ACB to each of the equal angles BCD and ACE, the angle ACD will be equal to ECB, and the sides AC and CD are equal to EC and CB. ∴ the triangle ACD is equal to the triangle BCE, or equal to AEC and half of ABC. Exactly in the same way it may be demonstrated, that the triangle ABD is equal to AFB and half of ABC ∴ the trapezium ABDC is equal to the pentagon BCEAF, and taking away the triangle ABC from both, there remains the equilateral triangle BDC, equal to the two equilateral triangles AEC and AFB. Therefore, &c.

By Mr. Boyd Willock, Kilmarnock.



In any right angled triangle, the equilateral triangle described upon the hypothenuse, is equal to the equilateral triangles described on the sides which contain the right angle. Let ABC be a right angled triangle, right angled at A; the equilateral triangle described on BC; the hypothenuse is equal to the equilateral triangles described on the sides AB and AC, which contain the right angle.

Upon BC describe the equilateral

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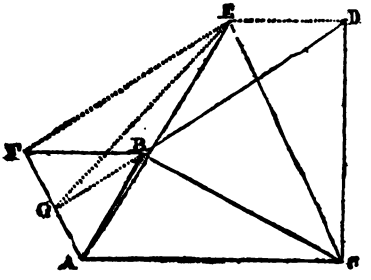
triangle BDC, and upon AB and AC the equilateral triangles BEA and ACH, and join AD, BH, and CE; and at the point A in the straight line BA, make the angle BAK equal to ABH, and join KE and KH.

Because the angle BAK is equal to ABK, the side AK is equal to the side BK; then comparing the two triangles BEK and AEK, we have BE in the one equal to AE in the other EK common, and the base BK equal to the base AK: hence the triangle BEK is equal to the triangle AEK, and the two AEK and BEK are double of BEK. But the two AEK and BEK are equal to the two AEB and AKB; therefore the two AEB and AKB are double of BEK. Again, because the angle KAB is equal to the angle KBA, and that the angles KAB and KAC are equal to the angles KBA and KCA; the angle KAC is equal to the angle KCA, and consequently the side KC is equal to KA, but KA is equal to KB, therefore KB is equal to KC; and because the triangles KBE and KEC are upon equal bases KB and KC, and between the same parallels, they are equal: hence the triangles KBE and KEC are double of the triangle BEK, but the triangles KBE and KEC are equal to the triangle BEC, therefore the triangle BEC is double of the triangle BEK. But it has already been demonstrated, that the two AEB and ABK were double of BEK; therefore the triangle BEC is equal to the triangles AEB and ABK. In like manner it may be demonstrated, that the triangle BHC is equal to the two AHC and AKC: hence the two triangles BEC and BHC are equal to the four AEB, AKB, AHC, and AKC; but the triangles AKC and AKB are equal to the triangles ABC, therefore the two BEC and BHC are equal to the three AEB, AHC, and ABC. Again, because the angle ABE is equal to the angle CBD, adding the angle ABC to each, the whole angle EBC is equal to ABD: then comparing the two triangles EBC and ABD, we have EB in the one equal to AB, in the other BC equal to BD, and the included angles equal; therefore the triangle EBC is equal to the triangle ABD: in like manner it may be demonstrated, that the triangle BHC is equal to the triangle ADC, therefore the triangles EBC and BHC are equal to the triangles ABD and ADC. But the triangles EBC and BHC have already been proved equal to the triangles AEB, AHC, and ABC; and since the triangles ABD and ADC are equal to the triangles BDC and ABC, therefore the triangles BDC and ABC are equal to the three AEB, AHC, and ABC: taking away the triangle ABC, which is common to both, the triangle BDC is equal to the triangles AEB and AHC. But the triangle BDC is the equilateral triangle, described upon the hypothenuse BC; and the triangles AEB and AHC are the equilateral triangles, described upon the two sides AB and AC, containing the right angle. Therefore, &c.

By Mr. Duncan Forbes.



Let ABC be a right angled triangle of which the hypothenuse is AC; the equilateral triangle, described on AC, is equal to the equilateral triangles on AB and BC. On AB and BC describe (1) the equilateral triangles AFB and BDC, and upon AC describe the equilateral triangle AEC on the same side with the other two triangles: join the vertices DEF, and produce DB till A meet AF in some point G; also join EG. Since every equilateral triangle is also (5 Coroll.) equiangular, $\angle ACE = \angle BCD$, and consequently $\angle ACB = \angle ECD$. In comparing the two triangles ACB and ECD, we have AC, CB, with the included angle = EC, CD, with the included angle: hence

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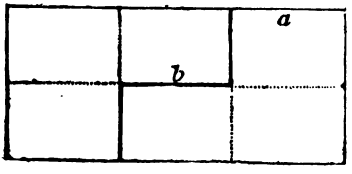
the two triangles are (4) every way equal; *i. e.* ∠ CDE = ∠ CBA, and the side DE = BA. Again, the three angles DBC, CBA, and ABG, are (13) equal to two right angles, and consequently the angles DBC and ABG are equal to a right angle = CDE; and as CBD = CDB, it follows that ∠ ABG = ∠ BDE. But ∠ BAG = ∠ CBD; hence the two angles BAG and ABG make a right angle; therefore (32) BGA is a right angle, and consequently BGF. In comparing the two triangles BGA, BGF, we find them every way equal (26); *i. e.* FG = GA and ∠ FBG = ∠ ABG = ∠ EDB ∴ FB is parallel (28) to ED; but FB = BA = (as we have shown) to ED ∴ FE is (33) equal and parallel to BD, and the figure FBDE is (34) a parallelogram. It is easy to show that the triangle AFE is every way equal to ABC (by prop. 8), or to EDC; and the parallelogram FBDE is equal to the triangle FAE, each of them being (37 and 41) double the triangle EFG. Now the whole figure ACDEF is composed of the equilateral triangle AEC, and the two equal triangles AFE and CDE, that is, of the equilateral triangle AEC, and twice the original ABC. Viewing the same figure otherwise, we find it composed of the two equilateral triangles FBA, BDC, and the parallelogram FBDE together with the triangle ABC, which is = FBDE, that is, of the two equilateral triangles FBA, BDE, and twice the original triangle ABC. It is evident then that the equilateral triangle AEC and twice ABC = the two equilateral triangles ABF, BDC, and twice ABC; and taking away the quantity, 2ABC from each, there will remain the equilateral triangle AEC, equal to the two equilateral triangles ABF and BDC. Wherefore the equilateral triangle described, &c.

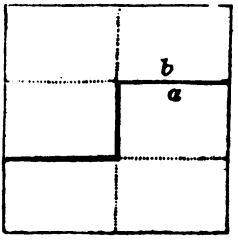
MECHANICAL SOLUTION OF MR. LUCOCK'S MECHANICAL EXERCISE, VOL. XII. P. 251. BY MR. UTTING.

Let a denote the side of the square, b the width of the board, x the number of equal parts into which the board is to be divided by lines in a longitudinal direction, and y the number of equal parts transversely.

Now, $x = \frac{b}{a-b}$ and $y = \frac{a}{a-b}$ ∴ $y = x + 1$.*

Fig. 1.





1. I shall first suppose the lid of the box to be 12 inches square, and the board to be 18 inches long by 8 inches wide.

Hence $x = \frac{b}{a-b} = 2$, and $y = \frac{a}{a-b} = 3$. Let the board be divided accordingly as in fig. 1; and if it be cut in a zigzag direction along the black line, and the letter a be brought under the letter b, as in the figure, the two parts will form a square. This is the most simple solution of which a question of this nature will admit.

* This simple formula is, I believe, original

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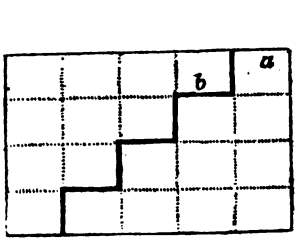
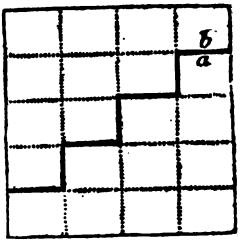
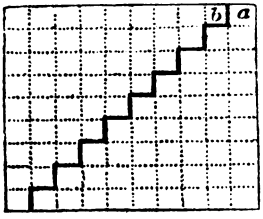
Fig. 2.

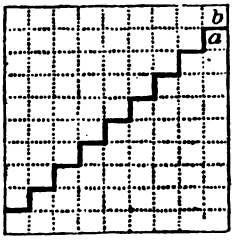




2. Taking the dimensions as given by Mr. Lucock, we have $x = \frac{b}{a-b} = 4$, and $y = \frac{a}{a-b} = 5$, or $= x + 1$.

Fig. 3.





3. Again, suppose the length of the board to be $13\frac{1}{3}$ inches, and the width 10·8 inches.

Hence $x = \frac{b}{a-b} = 9$, and $y = \frac{a}{a-b} = 10$, $= x + 1$, as before.

Now, if the boards be divided and cut as above directed, and the letter *a* be brought under the letter *b*, on each board respectively the squares will be completed, as was required; each square being composed of two precisely *equal* and *similar* pieces.

J. UTTING.

Lynn, Jan. 1830.

(Extract from a Communication subsequently received from Mr. Utting.)

I do not know whether it is known to you or to the generality of the readers of the "Mechanics' Magazine," that a demonstration of the above problem is given in Leslie's "Elements of Geometry," p. 313, edit. 3rd, 1817, very similar to that given by Mr. Hughes, vol. xii. p. 411, of "Mechanics' Magazine." The solution by Mr. Dowling, is, I think, the neatest, and the most entitled to originality of any of the answers given in the "Mechanics' Magazine." I was not aware that an answer was given by Bonnycastle. He, however, merely gives the figure without any direction whatever as to its *dissection*, which will, I trust, acquit me on the score of plagiarism.

A question is proposed by H. T. vol. xiii. p. 7, viz.—To demonstrate that "the equilateral triangle described on the hypothenuse of a right angled triangle, is equal to the equilateral triangles described on the other two sides." For a demonstration, see Leslie's "Elements," p. 309. It is also demonstrated in the same work, p. 189, that a *rectilineal* figure,

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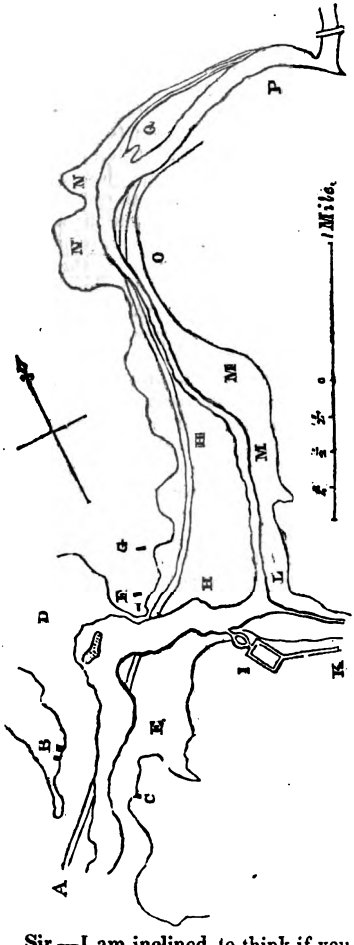
described on the hypothenuse, is equivalent to similar figures described on the other two sides. The same property obtains in any *rectilineal* figure whatever.

[Mr. Mackinnon has also favoured us with a solution of Mr. Lucock's problem on the same plan as that of Mr. Utting, and with some remarks on Mr. Dowling's method, which we should wish him to reconsider. Mr. M. insists that Mr. Dowling's is *no solution at all!*—Ed.]

IMPROVEMENT OF THE RIVER LUNE.



Sir,—I am inclined to think if you were furnished with, and were to publish from time to time, plans of the different navigable rivers in this country, it might be the means of exciting men of science to point out how they might be improved. Under this impression, I herewith send you a plan of the River Lune, taken by Messrs. Physick and Bush, surveyors, at the request of the Lancaster Mechanics' Library Committee, for the purpose of better enabling the members of that institution to compete for a prize which has been offered for the best essay on the means of improving the river. I am fully persuaded, that if you will allow it a place in the "Mechanics' Magazine," it may not only be of great service to this neighbourhood, by obtaining for us the opinions on the subject, of persons at a distance, but be the means of great improvements in other rivers. I should think that in the present instance much might be done by the power of steam-boats, in making the channel straighter. I hope some of your valuable correspondents will take this hint into consideration, and favour us with the design of a machine which could be worked by a steam-boat or vessel at tide-time; so that the sand raised during the flow of the tide might be forced through, and washed away by the return of the tide and the fresh water down the river. Suppose a steam-vessel were to work up the line, I have marked on the plan A, across the sand at tide-time, is it not very apparent that much would be done for the improvement of the river?

I remain, dear Sir,
Yours sincerely,
M. Saul.

Sulyard-street, Lancaster.

Description of the Chart.

A. is Mr. Saul's line of improvement. B. Sunderland. C. Thornbush. D. Sunderland Sands, about 60 acres. E. Thurnham Marsh, about 190 acres. F. Bazil. G. Chapel. H H. Overton Sands, about 370 statute acres. I. Glasson Dock. K. Canal. L. Conder Green. M M. Ashton with Stodday, about 200 acres. N N. Heaton Marsh, 137 acres. O. Aldcliff Marsh. P. Lancaster Marsh. Q. Salt-area.

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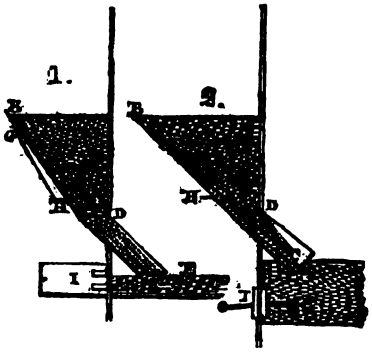
IMPROVED STEAM-ENGINE HOPPER.



Sir,—Should the above rough sketch of a hopper for feeding steam-engine furnaces meet with your approbation, I would thank you to insert it in your valuable Magazine.

A, fig. 1, represents a side view of the hopper, on which the lid B fits closely; C, the loose bottom or valve, which is hung on hinges at D, and opens inwards towards the furnace E; F a chain or rope fastened to the bottom of the hopper, and passed through a hole in the hopper, and over a pulley at G, and hooked by a ring at the end, on the pin H.

The mode of using this hopper is, to fill it with as much fuel as is sufficient for a single feed; the lid is then put down, and the chain unhooked from the pin H; the bottom C having then nothing to support it, immediately flies open from the weight of the fuel, and deposits the whole of its contents upon the fire, (see fig. 2.) The chain is then pulled up and hooked on the pin, and the hopper is ready for another charge.

The fire-door, I, may be made of the same size and form as usual, but should have a hole in it, through which a rake, as K, with a moveable handle, might move with facility, and might be used to distribute the fuel over the fire after every feed, when the handle should be removed, and the body of the rake left inside the fire-place. By this means the fire-door need not be opened more than three times a-day.

I do not pretend to know whether this apparatus would be applicable in every situation, but I think, wherever it can be adopted, it would not only effect a saving in fuel, by letting little air on the fire during the time of feeding, but would save the engine-tender from exposing himself to the glowing heat of the fire at every time of supplying new fuel, as is now the case, with fire-places on the old construction.

I am, Sir,
Yours, &c.

THOMS, T.

Liverpool, 9th May, 1830.

LONDON MECHANICS' INSTITUTION.

Sir,—On Wednesday, June the 2nd, at a general meeting of the members of the London Mechanics' Institution, they were called upon to confirm a law they had passed (although with great opposition) at the last general meeting, in March, to admit females as members of the institution; a thing calculated to bring it, in my opinion, into very great disrepute, as the transferable tickets to admit them to the lectures were quite sufficient. Now as the institution professes to "instruct its members in the arts they practise," of course it will be necessary to have lectures to instruct the *female mechanics* in the arts they practise—such as the getting up of linen, "chronicling small beer," &c. But how will this correspond with the dignity of a scientific institution, or with the designs of its founders? I cannot help noticing the very partial manner in which Dr. Birkbeck put the motion to the vote. There were, I believe, three persons who spoke upon it—two in favour of it, and one who had the good sense to say, that if it was passed into a law, the institution would be subject to the admission of females of a very questionable character. During the time the last member was speaking, Dr. Birkbeck amused himself with sundry contemptuous twitchings at what he was saying, and hardly gave him time to say what he wished, before he abruptly put the question to the vote. The consequence of putting it to vote in such a hurry was, that the Doctor got his own way, as there was (compared

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with the last meeting) but little opposition.

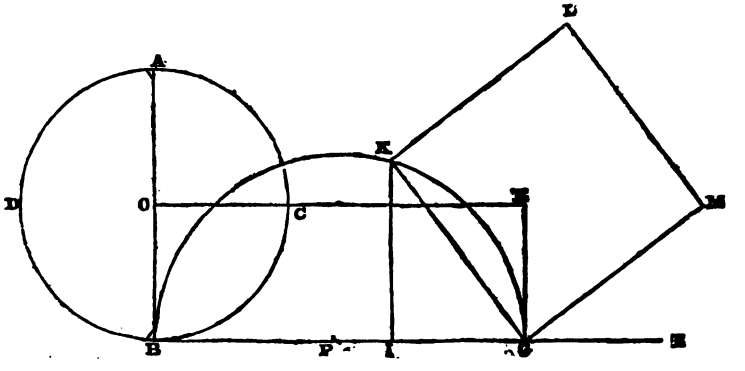
I am, Sir,
A MEMBER OF THE LONDON MECHANICS' INSTITUTION.

N.B. Our lectures for the last quarter, by Dr. Birkbeck, Messrs. Henning, Christie, Buckingham, Adams, Barry, Johnson, and Blake, on hydraulics and hydrostatics, have been good; but the members would be obliged to the latter gentleman if he would speak as if he intended them to hear him.

SQUARING THE CIRCLE—MAJOR-GENERAL OUSELEY'S METHOD.

Dear Sir,—I have just received a communication from General Ouseley respecting "Cui Bono's" objection (No. 353, p. 164), to his mode of constructing a square exactly equal in area to that of a given circle; the substance of which I subjoin.

"Cui Bono" asks, "How are we to know *precisely* when the right line upon the curve surface of the cylinder, which was first in contact with the plane surface, comes into contact with it again?" The General hopes that the following explanation will remove this difficulty for the ingenious "Cui Bono," and save Mr. Utting the unnecessary trouble he is about to take in finding the length of the rectangle, &c. The General divides this cylinder longitudinally by a plane passing through the centres of the ends; then the common sections of this plane and the curve surface will be straight lines, and truly mathematical lines—and, consequently, their extremities will be mathematical points. Now, the rectangle generated by the revolution of the half cylinder upon a plane surface will be exactly equal to the area of a circle whose diameter is the same, or equal to the diameter of the cylinder; the length of the cylinder in this case being equal to half its diameter. Or without dividing the cylinder into two equal parts, let us suppose ABD to



represent one of the circular ends of the cylinder, of which AB is the diameter, and that two notches are made at A and B, as in the figure. Evolve ACB upon the horizontal plane BE, and let G be the point in the straight line BE that A comes in contact with. Upon BG describe the semicircle BKG; make GI=BO join GK, and upon it describe the square GKLM. Then by the property of the circle $BG \cdot GI = GK^2$. But BG·GI is equal to the rectangle contained by the semicircumference ACB and the radius BO; which is well known to be equal to the area of the circle ABD; therefore the square KGML is equal to the area of the circle ABD.

I am, dear Sir,
Yours, &c.

AMICUS.

SQUARING THE CIRCLE.

Sir,—I have sent you the following remarks on the subject of squaring the circle as an appendix to

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my paper, vol. xiii. p. 165, and remain, Sir,

Yours, &c.

J. UTTING.

Lynn Regis, May 24, 1830.

The numbers frequently employed for finding the area and circumference of a circle are ·7854 and 3·1416 respectively. The same values will however result from the following process, viz.

·11 × 7 + $\frac{1}{10}$ part of their product = ·7854

And ·11 × 7 × 4 + $\frac{1}{10}$ part of their product = 3·1416

Example.

·11 × 7 = ·77	11 × 7 × 4 = 3·08
$\frac{1}{10}$ + ·0154	$\frac{1}{10}$ + 0616
Area = ·7854	Circumference = 3·1416

The circumference of a circle, computed according to the above proportion, will not vary the $\frac{1}{1000}$ part of an inch, the diameter of the circle being 30 feet.

But generally I think the result required is obtained with greater facility by means of tables of the factors ready computed for the nine digits, as in the annexed tables, which method I have practised for many years:—

	Area.		Circumference.
1	7853981634	1	31415926536
2	15707963268	2	62831853072
3	23561944902	3	94247779608
4	31415926536	4	125663706144
5	39269908170	5	157079632679
6	47123889804	6	188495559215
7	54977871438	7	219911485751
8	62831853072	8	251327412287
9	70685834706	9	282743338823

From the above table it is required to find the area and circumference of a circle whose diameter is 25?

Example.

d^2 = 625·	d = 25
471238898	6283185307
15707963	1570796327
3926991	
Area = 490·873852	78·53981634 Circumference.

The above results are obtained by the method of contracted multiplication. The multipliers, *i. e.* the diameter and its square, are placed in their natural position (and not inverted), and the multiplication commences with the left-hand figure of the multiplier, instead of the right, as in the usual practice.

It will be seen by inspecting the above table of areas, that all the products of the 9 digits, except that of the first or unity, must be placed one remove towards the left-hand instead of being placed directly under the figure by which the result is produced. The same attention is required in the table for finding the circumference, except the products of the three first digits, which are to be placed directly under the figures producing the said products, the same as the product by unity in the table of areas. There is no difficulty in pointing off the integers, as the circumference is 3 times that of the diameter, and the area $\frac{3}{4}$ of its square nearly.

Having the diameter of a circle given to find the side of a square whose area is equal to that of the circle—multiply the diameter by ·8862269255; or multiply the circumference by ·2820947918. The diameter of a circle is in proportion to the side of an equal square, as 800 to 709, very nearly. If the diameter of a circle be 30 feet, the side of an

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equal square, as found from this proportion, will not vary the $\frac{1}{710}$ part of an inch from the truth.

The above methods are the most simple that I can discover. There is absolutely no such thing as a *correct method* of squaring the circle, as all the methods hitherto employed are evidently *approximative* only. The following formula will give the circumference true to 12 places of figures, viz.

$$\frac{84823}{27000} = 3{\cdot}14152259259$$
$$\frac{61}{1000{\cdot}000{\cdot}000} + \cdot00000006100$$

Circumference $= 3{\cdot}14159265359$

which is correct in the last figure. This formula is very easily applied to practice, as in the first term we have only to divide by 27, viz. 9×3; and in the second term no division is required; we have merely to multiply the diameter by 61, and point off the decimals in the product.

I do not, however, recommend the formulas which I have given to be used in practice generally, although perhaps the most simple which can be applied; as, after all, I think with your correspondent, "Cui Bono," that the area of a circle is more easily obtained from the factor ·78539, &c., particularly when the factor is taken from a table such as I have given in this paper.

J. UTTING.

P. S.—If the diameter of a circle be given, and a right line could be found *exactly* equal to the circumference, the circle might be squared, as well as any right-lined figure whatever; *i. e.* a square might be constructed whose area would be equal to that of the circle. Let $2r$ denote the diameter, and $2c$ the circumference of any circle, then will rc be its area. Now, let x be the side of a square whose area is equal to that of the circle, and we shall have $x^2 = rc$; whence x will be a mean proportional between r and c, and may be found by Euclid, prop. xiii. book vi. But it is impossible, from Euclid's *postulate*, having the diameter of any circle given, to find a right line exactly equal to the circumference, and therefore the circle cannot be squared upon the same principle as we are taught to square all right-lined figures; nevertheless, as Euclid's *postulate*, however simple it may appear in theory, is not capable of being perfectly executed—as errors will arise, in drawing and producing lines, in taking the distances of points, &c.—and as the circumference of a circle may be had from the diameter to any assignable degree of accuracy, it follows that in *practice* a circle is as capable of being squared as any other figure whatever, although not *rigorously* on geometrical principles.

REVIEW OF PAPERS ON FLYING. BY MR. JOHN HARRISON.

(*Continued from p.* 403, *vol.* xii.)

Sir,—In continuing my remarks on the different articles on flying, the communications of W. C. (the late Sir W. Congreve), in No. 240, are next to be attended to. This correspondent cannot be accused of exaggeration in describing the resistance of the air, since, at a moderate temperature and density, it is really greater than he has stated; so that his calculations underrate the effect of objects moving therein with different velocities, and presenting different quantities of surface. But as to 600 pounds being raised ten feet in one minute, or 300 pounds four inches in a second, by one man, the effort is certainly too great to be continued for any length of time; and W. C. is manifestly in error as to the effect of his propellers. He calculates upon half of the vanes of his propellers producing full effect, whereas this is by no means the case—such effect is only produced at one single point of their whole revolution. The tendency of the machine to ascend being effected by the descent of the vanes, it follows that in all parts of the semicircle where the descending velocity is less than the real velocity, the effect will be less in a duplicate ratio. The top and bottom vanes move horizontally and edgewise (see the delineations, No. 240), consequently as they have no descending motion, they give no aid; and it is only as the vanes ad-

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vance from the perpendicular of the axis that they acquire a descending motion, which is at its maximum only in the indivisible instant when the arm of the wheel is in an horizontal position. Were the effect of all the descending vanes constantly a maximum, then the ascensional tendency of the machine might correspond with the result he gives, viz. four inches in a second, deductions being made therefrom for the counter-resistance of the ascending arms and vanes, &c.; but as the real effect must be greatly short of his calculations (as made from the maximum descent of the vanes), and those deductions being also made, the ascensional tendency must of course be greatly reduced. Besides, the effect of each vane will be less in some degree as their number is greater; since the preceding vane, by giving a descending motion to the air, must consequently reduce the effect of that which succeeds. Nevertheless, it is obvious that some degree of ascensional power will still remain, and, therefore, there could be no doubt respecting the accomplishment of a thing so extremely desirable and fraught with such beneficial results, were it not for one single property in the machine and its load; *namely*, that while it has a positive ascensional power of, perhaps, two inches in a second, it has a descensional tendency sixteen feet in the same time.*

There are other instances of W. C.'s oversight with regard to the tendency of the machine to the earth. In describing the effect of his propellers, page 131, he tells us, that if the plane of parallelism of the vanes "be so adjusted as to make an angle of 45 degrees with the horizon, then their joint tendency will be to advance the machine one foot horizontally for every foot it rises perpendicularly:" which manifestly shows that its gravitating tendency of 16 feet in a second had so completely eluded his apprehension as not to be taken into the account. And the same unaccountable inattention to this powerful law is also observable in his description of the effect of the vanes, fig. 3, on the same page.

His ideas are also extremely erroneous with respect to *the power* required to sustain the machine in air. He informs us, that it has been ascertained that a surface of a foot square impinging on the air with a velocity of 100 feet per second, will hold about 15 pounds in equilibrio: and though in No. 243, page 186, he shows the resistance to be greater than this, yet *as it is power only that can make resistance available to the intended purpose*, it follows that this is irrelevant, because (correspondent to his misconception of the matter) we shall find a deficiency of power to an enormous extent. Taking a cubic foot of air at *an ounce*, instead of 15 pounds, he finds the resistance 19 pounds 8 ounces. A cubic foot of air at a mean density is, however, about $1\frac{1}{6}$ ounce; of course the resistance is still greater. From the subjoined table of Mr. Smeaton on the strength and velocity of the wind,† we find the resistance of the air to a square foot moving 100

* Though 300 pounds might be raised four inches in a second by one man when sustained on a solid foundation, yet when aloft in air where there is no such support, he must necessarily descend like every thing else, with only the abatement which his strength can effect = 16 feet, minus 4 inches, or rather half the quantity in a second.

† *Mr. Smeaton's Table of the Velocity and Force of the Wind.*

Miles per hour.	Feet per second.	Perpendicular force on one square foot in pounds avoirdupoise.	
1	1·47	·005	Hardly perceptible.
2	2·93	·020	Just perceptible.
3	4·4	·044	
4	5·87	·079	Gently pleasant.
5	7·33	·123	
10	14·67	·492	Pleasant brisk.
15	22·	1·107	
20	29·34	1·968	Very brisk.
25	36·67	3·075	
30	44·01	4·429	High wind.
35	51·34	6·027	
40	58·68	7·873	Very high wind.
45	66·01	9·963	
50	73·35	12·300	Storm or tempest.
60	88·02	17·715	Great storm.
80	117·36	31·490	Hurricane.
100	146·7	49·200	Hurricane that tears up trees and carries buildings before it.

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feet per second, to be 22,865 pounds. But as the air is subject to considerable variation in density, and is also rarer at greater heights, 20 pounds is the utmost that can be allowed for the purpose of flying. W. C. estimates the man and machine at 300 pounds; and he presumes entirely on his ability to raise and support himself and the machine in this medium just as he would do the same weight on a solid foundation, and he computes the force required accordingly. He provides what he supposes equivalent to four inches ascent, but does not perceive the sixteen feet descent! He does not seem to have the least idea of the prodigious disadvantage the man must labour under to support 300 pounds by such a rapid motion of the vanes as the yielding of the air, and its slight resistance renders necessary (to say nothing of the additional disadvantages of counter-resistance and friction); although from the data he has given, the power required to be applied to the winch which gives motion to the vanes is easily determined —there being only the velocity of the vanes to consider, and the length of the winch and the rate at which it is to be turned, so as best to suit the aeronaut, that his power may be applied with the greatest effect and least fatigue. Now the most convenient length for a winch, for applying at once both force and quickness of motion, is perhaps between 14 and 15 inches: admit the handle to move through a circumference of 90 inches (which gives a radius of 14·3 inches for the winch), and let it make one revolution in three seconds, it will move through a space of 2½ feet per second.

With respect to the velocity of the vanes:—It is clear that the slower these move, the less power will be required to give them motion, because their velocity will less exceed that of the handle, and consequently (in principle) the resistance by which the weight is sustained acts at the end of a shorter lever. But because the area of the vanes requires to be inversely as *the squares* of their velocity, it follows that such a quick increase in their size will not permit them to move very slow. W. C. has fixed their velocity at 36 feet per second; we will therefore examine what sized vanes are adapted to this velocity to lift 300 pounds, and also the power that will be required to produce such velocity.

(To be continued in our next.)

DR. CHALMERS AND THE MECHANICS MAGAZINE.

About two weeks ago the Editor was incidentally informed that in the course of a sermon recently preached by Dr. Chalmers in the Caledonian Church, that eminent divine had taken occasion to stigmatize *by name* the "Mechanics' Magazine" as a work which has for its object to corrupt the public mind by the dissemination of atheistical and anarchical principles! It seemed to him so utterly incredible that Dr. Chalmers could have said any thing so void of truth, that he did not at first give much credence to the report of his informant; but having subsequently made it his business to see several other respectable individuals who heard Dr. Chalmers on the occasion alluded to, he was compelled by their concurring testimony to come to the painful conclusion, that Dr. C. had actually made use of the calumnious expressions ascribed to him. He therefore instructed a friend (Mr. Evans) to seek an interview with Dr. C., and to represent to him that in what he had said he had been guilty of the greatest possible injustice to the "Mechanics' Magazine" and its editor; that so far from meriting the character of disseminating culpable opinions in religion and politics, the "Mechanics' Magazine" has never, through the course of a long and prosperous career, meddled with either the one or the other; that it is a work entirely devoted to the diffusion of information on scientific and mechanical subjects, and has pursued its peculiar course so free from every taint of religious or political impurity, as to be honoured with the approbation of some of the most responsible members of his Majesty's government, and with the active support of men almost as distinguished as Dr. Chalmers himself for their advocacy of Christian principles, and for a rational attachment to the existing institutions of

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their country; that it was evident Dr. C. could not himself have read the work which he denounced, but must have derived his notions of it from the false representations of others; and that, no doubt, was entertained that Dr. C., when made sensible of the error into which he had been betrayed, would be anxious to make, instantly, every reparation in his power. Mr. Evans did not succeed in obtaining a personal interview with Dr. Chalmers, but having left for him, with a member of his family, a statement in writing to the above effect, along with copies of the two last parts of the Magazine, that the reverend gentleman might have an opportunity of judging for himself of the real character of the publication, he was next day favoured with the following letter. It will be seen that though Dr. Chalmers did not, in truth, say that of the "Mechanics' Magazine" which has been ascribed to him, he made use of the words "*Mechanics' Magazine*" in a way which accounts very naturally for the erroneous impression which has gone abroad on the subject. It is scarcely possible indeed that any person who heard Dr. Chalmers on the occasion in question could have come away with a different impression; and much we doubt, whether even the strong disclamation which we have now the pleasure of subjoining, will ever counteract all the injury which that naturally erroneous impression is calculated to produce.

Dr. Chalmers to Mr. Evans.

Sir,—I regret that I missed your call; else I should have assured you in word what I now most cheerfully do in writing, that the complaint of you friend, Mr. Robertson, is grounded on an utter misconception. I put hypothetically the case of two extremes in sentiment on the question of popular education—the one exemplified by a patrician of high family, full of loyalty to the King, but adverse to the instruction of the working-classes; the other as exemplified by a Mechanics' Magazine, if tainted by a spirit of radicalism throughout all its pages. I had no actual patrician in my eye when thus attempting to illustrate my view, and most assuredly no actual "Mechanics' Magazine." Nor would I have employed the illustration at all, if I had thought that by any possibility it could have proved injurious to the feelings or interests of any one. I have looked with pleasure into the two specimens you have sent me of your friend's periodical work, and I cannot help thinking that next to direct Christian instruction, such a journal, conducted on the principles which it avows, and adequately supported by the public demand, is entitled to rank among the most efficient of those auxiliary means which are now in operation for raising the character, and eventually the condition of the people at large.

I am, Sir,

Your obedient servant,

THOMAS CHALMERS.

Richmond, June 3, 1830.

INTERIM NOTICES.

"Miles" complains that we have not kept our promise of sending a free copy of No. I. of the "Spirit of Literature" to each of the Subscribers to the "Mechanics' Magazine;" and similar complaints have reached us from other quarters. The fault does not lie with us; a gratis copy of the new work was sent out with every copy of No. 355, delivered from this Office.

We would willingly oblige B. J. who writes to us about a late concert at the Mechanics' Institution (Will they never have done with such shifts?) but his complaints resolve themselves into a matter of accounting unfit for our pages.

Mr. James's letter on the subject of promoting combustion by exhaustion, is, on account of the engraving, necessarily deferred till next week, when we shall give also two other letters we have received in reference to the same matter.

Communications received from H. B——k—Mr. M'Duff—R. C. Jun.—Mr. Hopwood—P. Puff—Mr. Dudley—Mr. Utting—Mr. Baddeley—S. C. J.—Nemo, jun.—W. S.—Peter Pressure—Mr. Barnard—Mr. Shires—X. Y. Z.—A. P.—Hezron—D. Thomas—T. H.

Errata in our last Number.—The relative proportions of ancient bridges, page 227, should be altered as follows:—

"Illyssus at Athens," for $\frac{1}{5}$ read $\frac{1}{12}$.

"Loire at Orleans," for 5579, read 5·579.

"Rimini," for $\frac{1}{5}$ read $\frac{4}{13}$.

In the same list, for "over the Seine at Nantes," read "over the Seine at Mantes."

P. 228, for "150 feet," as the span of New London Bridge, read "152 feet."

For "Derbyshire granite," read "Devonshire granite."

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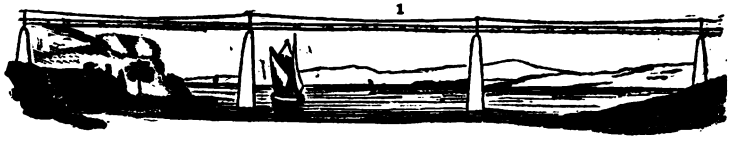
Mechanics' Magazine,

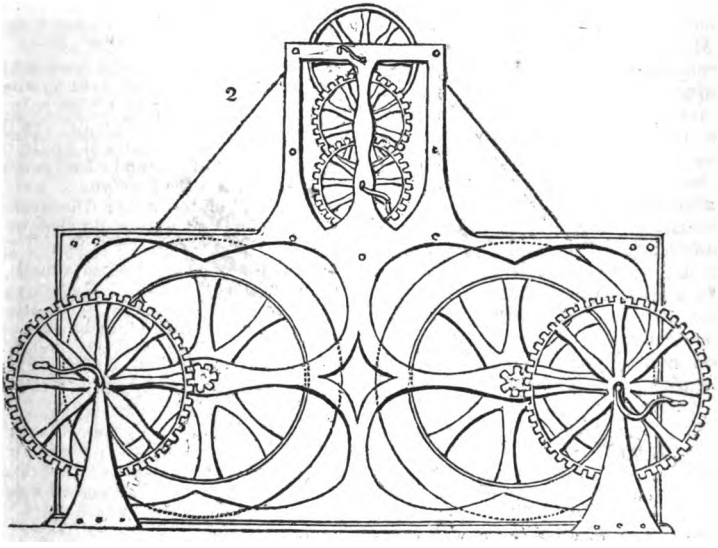
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

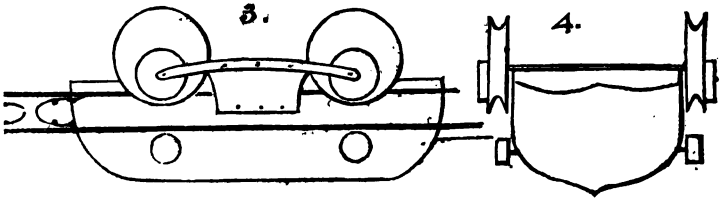
No. 358.] SATURDAY, JUNE 19, 1830. [Price 3*d*.

"Were not genius and invention seconded by industry and perseverance, the brilliancy of genius would be merely the blaze of a passing meteor, and the cunning of invention would be rendered of no avail."—Dr. JOHNSON.

DICK'S SUSPENSION-RAILWAY.







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DICK'S SUSPENSION-RAILWAY.

Mr. Maxwell Dick, a gentleman of Ayrshire, is now exhibiting in a room at Charing Cross, the model of a railway on the principle of suspension, which he states to be of his invention, and models also of carriages adapted to it. The exhibition is well deserving of a visit from the admirers of mechanical ingenuity; for whatever may be said of the originality of the plan, too much praise cannot be bestowed on the dexterity with which Mr. Dick has managed to exhibit to the eye on a small scale, all the details of its practical operation, or on the spirit and perseverance which has led him to take this rather expensive method of bringing it under the notice of the public. Our readers do not require to be told that the idea of a suspension-railway is by no means new—that is to say, a railway supported by piers, raised at different intervals, and along which carriages are to travel, wheels uppermost. Precisely the same thing was suggested four or five years ago by Mr. H. R. Palmer, who proposed by means of a single railway of this description to convey goods and passengers in a couple of hours from London to Brighton. We do not suppose that Mr. Dick was at all aware of what Mr. Palmer had done: he makes no mention of that gentleman in the explanatory Description which he has published; and he gives the following very natural account of the manner in which the plan suggested itself to him, and of the preliminary experiments which satisfied him of its practicability:—

"In consequence of a very heavy fall of snow at the beginning of March 1827, much inconvenience was occasioned to the commercial and general interests of the country. For several days the roads throughout the country were completely blocked up, and travelling was wholly suspended. Experiencing, with others, the disadvantages thus occasioned, I thought of recommending to road-trustees the trial of a snow-plough, simple in construction, and trifling in expense. But the design of a railway, on the principle of *suspension*, occurred to me as the one most likely to overcome the whole difficulty: besides, it would afford a safety in rapid communication with light carriages practicable by no other means known to me. Being satisfied in my own mind of the success of the plan, I erected a temporary railway in a private apartment, and made my first experiments with a carriage something similar to those I now exhibit. The result of these experiments seemed so favourable, that I determined to try them on a more extensive scale. Accordingly, in the summer of 1829, I erected a line of poles, extending about two miles, on a farm, near Irvine, belonging to his Grace the Duke of Portland. From the one end of this line I laid a rail of *rope*, about half-inch thick, upon which I placed the carriage; and taking the moving power to the other end, I set it in motion, and the velocity gained exceeded the rate of thirty miles an hour. This was over a rope-rail of rough surface; the carriage was twelve pounds in weight, and the diameter of its wheels only two inches and a half. In order to ascertain the power of drag required, I attached a four-pound weight to a line passed over a pulley screwed on the top of a high pole at the one end, and the following was the result:—The first quarter of a mile required a force of four and a half pounds weight to raise the four-pound weight to the top of the pole; the second quarter required a force of five pounds weight—increasing a half pound (or as near it as could be ascertained) in each quarter of a mile. This experiment was made with a spiral steelyard. The whole weight of line, extending two miles, was six pounds—the force required to drag over pulleys the two miles of line, and to raise the four-pound weight, was eight pounds, or two pounds less than the real weight dragged. This experiment was made with a very imperfect apparatus, or I am convinced the result would have been still more favourable."

A perspective sketch of a railway on Mr. Dick's plan is exhibited in fig. 1, of the accompanying illustrations. The mode of propelling carriages along it is thus described:—

"The method proposed for dragging the carriage along the railway is, by fixed or stationary engines, acting with drag-lines or ropes attached to the carriage, which, if the railway be double, will act in an endless round; but if the line of railway be single, then the engine will be interchangeable and reciprocal. The one end of the drag-line is first coiled round the

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band-wheel of the engine—then passed down on the large barrel-wheel, which coils up the whole; and, on the return of the carriage, the barrel-wheel is ungeared from the engine, and the line again passed out. With a train of six half-ton carriages, a water-proof drag-line of half-inch in diameter, will be sufficient upon all stages, unless it be very hilly; then the strength of line, length of stage, and power of engine must be in proportion: and should the large barrel-wheel be nine feet in diameter and four feet broad, 196 revolutions of this barrel-wheel will coil a mile of rope; in other words, the build of a five-mile coil upon such a barrel will not exceed 5 inches; but the strength of line and power of engine must depend entirely upon the level of the country, the weight to be drawn, and the velocity to be obtained. This method of drawing carriages is already well known; but I add, as an improvement to the engine at present in use, two teethed-wheels and two pinions, by means of which a velocity with light carriages is gained, far exceeding any thing before gained by wheel-carriages. A plan or sketch of this engine is given in fig. 2, exhibiting hand-cranks upon each axle, which, with light carriages, is intended to be wrought by manual power; but when heavy carriages are to be used, steam, horse, or other power may be applied. A double engine, placed in the middle of a stage of double railway, may keep two carriages in constant motion; and thus, by the alternately active and passive agency of two ropes or lines, the powers of fixed engines are made to act in opposite directions: thereby causing a road to be traversed both ways at once with great despatch. A water-fall, with a double reciprocating engine, in whatever part of the stage placed, may be taken advantage of, or the power may, on the level or slightly inclined stages, be wrought with the light carriages, simply by extending a stationary line, the tension of which would be self-acting by means of weights attached at both ends, and by passing this line once round a barrel-wheel fixed at the bow of the carriage, there might, by the addition of a teethed-wheel and pinion, with light carriages containing four or five passengers, a great velocity be gained; which carriage might be propelled either by the passengers themselves, or by men for the purpose. By this means, one carriage might succeed another in as quick succession as they choose. With the patent friction carriage upon a level stage, the power of one man would be sufficient to take forward a carriage of twelve cwt. at a great velocity; besides, having the power at their own command, they would be enabled to stop at pleasure. Powerful barrel-springs may also be employed to advantage as a moving power in particular situations. The rail-road, however, is the principal object, the moving powers being many, from the spring to 100 horse-power-engines, if required."

Fig. 3, is a side view of one of Mr. Dick's proposed carriages, with a section of the bearing and safety rails and safety wheels.

Fig. 4, is a front view of the carriage.

For other details respecting the mode of erecting and bracing the rails, and securing the carriages from danger, we must refer to Mr. Dick's pamphlet, which is very circumstantial, and illustrated by nineteen engravings in addition to the four which we have here copied from it.

Mr. Dick estimates that the cost of a railway on this plan would be only about £1400 per mile, which is about two-thirds less than the average expense of a ground rail-road. Among the other advantages claimed for it, the most undeniable are these, that a suspension-rail "takes a straight-forward point from one town to another, without regard to the surface of the country over which it has to go, whether rising or falling," (a perfect level being obtained by merely varying the heights of the pillars), and that its height above ground "allows every agricultural and commercial intercourse to go on under it without interruption," and excludes every chance of the many accidents which must attend travelling at great rates of speed on ground railways. Mr. Dick admits that such a railway would not be so well calculated as a ground railway, for heavy weights; but he meets this objection by remarking, that "by having waggons of half a ton a greater number may be taken in the train;" and that "with a light rail you will with light carriages have the same

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work done in the end." There is a more important objection, however, which Mr. Dick overlooks altogether; namely, the difficulty of immediately removing a carriage from off a railway of this description, in the event of its getting damaged while proceeding from one station to another with a number of other carriages in its train. The stoppage of one carriage might not only cause the stoppage of all those behind it, but be attended with collisions, frightful in proportion to the velocity of the carriages at the time of the interruption. We do not mean to say that the difficulty of immediately removing a carriage thus damaged may not be altogether obviated; we wish only to point out how necessary it is that some means should be devised for the purpose. We are satisfied that for great speeds —such speeds as it is now common to anticipate, fifty and sixty miles per hour, for example—a suspension-railway is, on account of its greater safety, and entire exemption from interruptions (saving only through the failure of the engines), infinitely preferable to a ground railway; and nothing would give us more sincere pleasure than to see every obstacle to their adoption in such cases removed.

PORTLAND BREAKWATER.

Sir,—You richly deserve the thanks of the public for giving the wide circulation of your popular miscellany to Mr. Harvey's truly interesting project in reference to this magnificent work. There can be no question, I think, as to the comparative facility with which such a breakwater might be constructed of the cap-stone, now almost entirely useless from the Portland quarries; nor any question that the expense would greatly, if at all, exceed that assigned in Mr. Harvey's estimate. Yet there are, I humbly conceive, some points of grave import, which ought to be cautiously, scientifically, and deliberately weighed, before this undertaking, grand and beneficial as it may notwithstanding be, be commenced.

With regard to the Cherbourg Breakwater, to which Mr. Harvey so strenuously adverts, I have more than once been assured that it is, as yet, an undecided question, whether or not that breakwater will not, in a very few years, *ruin* the port it was intended to defend, by encouraging deposits of sand, &c. in unfavourable situations, and with greater rapidity than they can be removed by artificial means.

Now, are we *quite* sure that the proposed breakwater at Portland would not be productive of some such evil at Weymouth? If we cannot arrive at nearly positive certainty on this head, it is, at least, advisable to suspend even an application to parliament or to government for a season, that a few preliminary inquiries and experiments may be made: for although it is comparatively easy enough to send the stones down from Portland's heights into the sea, yet when once there, however desirous the inhabitants of Weymouth may be to "call them from the vasty deep," they will find it beyond all human means (including *pecuniary* means) to get them raised from their "ocean bed."

If, now, so humble an individual as myself were consulted upon this momentous question, I should say, supply me with information upon the following points, and then I may offer a conditional judgment:—

1. Determine the soundings at every *furlong* from the commencement of the proposed breakwater to Lulworth Cove.*

2. Ditto from the said commencement to the Burning Cliff.

3. Ditto from ditto to the shore nearest the Weymouth Turnpike-gate.

4. Ditto from ditto to the little pier near the Look-out, or the Nothe.

5. Ditto at every half furlong from the said Look-out Pier to the shore nearest the Turnpike-gate.

6. Ditto from the Look-out Pier to the village of Chesil, on Portland Isle.

These soundings would be very instructive. But farther, I should require a comparison of the times of high-water and those of low-water,

* This may be easily done by the method described at p. 204, of the American translation of Sganzin's "Civil Engineering," sold by Kennet, Great Queen Street.

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at the Bill of Portland, at the village of Chesil (West Bay side), at the proposed commencement of the breakwater, at Lulworth Cove, at Weymouth Pier-head, and at the Ferry-house (two miles from Chesil), in every state of the tide, and under all the usual sets of the wind.

I should also ask, and if I could not otherwise obtain the information, I should endeavour to infer from the answer to the preceding inquiries:

Whether in case of making the breakwater, it would occasion more or less water with each, or with the usual tides, to come immediately to Weymouth, in front of the Esplanade?

Whether, that is, it would tend to increase or to diminish the shallowness of the water in the beautiful little bay immediately fronting Weymouth?

Whether, in fact, there might not be considerable danger of the whole space between the Look-out Pier and the Turnpike-gate being left dry, or what would be worse, like the sands at Ryde (Isle of Wight), for half the interval between two successive high-waters?

Whether the current, in the most prevailing winds, would set more than now upon the shore between the Turnpike and the site of the Race-course, or a little more to the west of the Turnpike-gate? And if the latter, whether it might not soon find its way across the road, and make a junction between the sea and the *backwater*, at a place where they are *now*, I think, not separated by an interval of 40 yards?

Another series of inquiries respecting the probable operation of the proposed breakwater upon the Chesil Bank (between the village of Chesil and the Ferry) would also readily suggest themselves; but I fear I must not enter upon them at present.

You know, Sir, that I am not an inhabitant of Weymouth. But being, unfortunately for myself, obliged to saunter away much of every summer at different watering-places, I have more than once spent some weeks very pleasantly at Weymouth. Though a saunterer when there, I have not been an idler, but have built some castles in the air—none, I admit, so splendid as Mr. Harvey's for the water. I sincerely wish that all my doubts of its want of feasibility may be baseless; and shall rejoice to see the "Mechanics' Magazine" made the medium of my conviction: being,

Mr. Editor,

Always yours,

O. C. F.

June 7, 1830.

FORMULA FOR THE CALCULATION OF PIT-MACHINERY.

Sir,—The following problem was suggested to me by a practical man in a difficulty during a visit I paid to a coal-work in the south of Shropshire, where flat ropes are made use of; and as it is of some utility, and admits of a neat and simple algebraical solution, it will, I doubt not, be acceptable to some of the readers of your useful publication.

Problem.—To determine the diameter of a circular ring which shall in a given number of revolutions receive on its circumference a given quantity of flat rope, of a given thickness, each succeeding band winding upon the next interior to it.

Let x=diameter of the ring in inches.
n=number of revolutions.
l=length of rope in inches.
a=thickness of do. in do.

The ring being circular, it is evident that the rope will be formed round it in concentric circles the diameter of the interior band being the diameter of the ring+twice the thickness of the rope; that the diameter of each succeeding band will be twice the thickness of the rope greater than that of the next interior to it; and that therefore the diameters of the interior band, the second, third, and so on to that of the last but one, and the last or the n^{th} band, will vary respectively, as $x+2a$, $x+4a$, $x+6a$, &c. &c. $x+2(n-1).a$, $x+2na$; that is, if we take the measure from the exterior of the rope: But taking it from the middle of the rope, the diameter of the first will be $x+a$, that of the second, third, and so on to the n^{th}, will vary, as $x+3a$, $x+5a$, &c. &c., $x+\overline{2n-1}.a$ respectively; and taking this case as the best adapted to practice,—

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$\therefore (x+a)\,\pi =$ circumference of the interior band $\pi = 3{\cdot}14159$
$(x+3a)\,\pi =$ do. next in do. do.
$(x+5a)\,\pi =$ do.

And so on, and generally;

$(x+\overline{2n-3}.a)\,\pi =$ do. of $\overline{n-1}^{th}$ band.

$(x+\overline{2n-1}.a)\,\pi =$ do. of the n^{th} or exterior band.

And by the problem the sum of all these circumferences must be equal to the length of the rope.

$$\therefore \left\{(x+a)+(x+3a)+(x+5a)+\text{to } n \text{ terms}+(x+\overline{2n-3}.a)+(x+\overline{2n-1}.a)\right\}\pi = l.$$

that is, $\left\{x \text{ taken } n \text{ times} +(a+3a+5a, \&c. +\overline{2n-3}.a+\overline{2n-1}.a)\right\}\pi = l.$

$$\text{or } (nx+a+3a+5a\ldots.+\overline{2n-3}.a+\overline{2n-1}.a)\,\pi = l.$$

Now let $a+3a+5a+$, &c. to n terms, $+\overline{2n-3}.a+\overline{2n-1}.a = s$, inverting this series and putting each term in a general form,

$$\therefore \overline{2n-1}.a+\overline{2n-3}a+\text{ \&c. \&c.}\ldots..(2n-\overline{2n-1}).a = s$$

$\therefore 2n.a+2na+$ &c. to n terms $2na = 2s$.

$\therefore n^2a = s$.

and substituting this value of s.

$$\therefore (nx+n^2.a)\,\pi = l.$$

$$x+na = \frac{l}{n\pi}$$

$$\therefore x = \frac{l}{n\pi} - na,$$ from which simple equation the other terms being given, we can determine either the number of revolutions, the length to be wound up, the thickness of the rope, or the diameter of the ring.

1. The number of revolutions which it will be necessary for the ring of a given diameter to make in winding up a given quantity of flat rope of a given thickness, is determined as follows:

From the equation $x = \frac{l}{n\pi} - na$, we have $n^2.a+n.x = \frac{l}{\pi}$, a quadratic equation which must be solved; dividing therefore by a, and completing the square,

$$n^2+\frac{x}{a}+\frac{x^2}{4a^2} = \frac{l}{\pi a}+\frac{x^2}{4a^2}$$

taking the square root,

$$n+\frac{x}{2a} = \pm\sqrt{\frac{l}{\pi a}+\frac{x^2}{4a^2}}$$

$$\therefore n = \pm\sqrt{\frac{l}{\pi a}+\frac{x^2}{4a^2}} - \frac{x}{2a},$$ and is therefore known.

2. The length of rope of a given thickness which can be wound upon a ring of a given diameter, in a given number of revolutions, is determined by the equation,

$$l = (nx + n^2\,a)\,\pi.$$

3. The thickness of the rope, so that a given quantity of it shall be wound upon a ring of a given diameter, in a given number of revolutions, is determined merely by transposing the equation,

$$x + na = \frac{l}{n\pi},$$ and dividing by n.

$$\therefore a = \frac{l}{n\pi} - \frac{x}{n}.$$

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Cor. If the rope be supposed to be without thickness, or indefinitely small, $a = o$, and $\therefore na = o. + \therefore$ the equation $x = \frac{l}{n\pi} - na$, becomes $x = \frac{l}{n\pi}$ which is the expression for the diameter of a cylinder which receives *a line* of a given length winding upon it, in a given number of revolutions.

N. B.—If we had taken the measure of the diameters from the outside of each of the bands, or from the insides, the diameters, as shown above, would have varied as $x+2a$, $x+4a$, &c., to the n^{th} band $x+2na$, or as $x+o$, $x+2a+x+4a$....&c., $x+2n-2$, respectively, and proceeding, as before, for the summation of these series, we shall find exactly in the same manner:—

$$x = \frac{l}{n\pi} - \overline{n+1}.a, \text{ for the former;}$$

$$\text{and } x = \frac{l}{n\pi} - \overline{n-1}.a, \text{ for the latter.}$$

Now for a practical case, and the one proposed to me may as well be taken as any other.

A circular ring of 40 inches in diameter fixed on an axis, to which motion is communicated by means of a steam-engine, draws up from a shaft 80 yards deep by means of a flat rope one inch thick; and it is required to find the diameter of another ring, to be fixed on the same axis, and which revolving with it, shall wind up from a shaft 155 yards deep in the same time.

First, we determine the number of revolutions which the ring of 40 inches in diameter makes by substituting the respective numerical values in the equation $n = \sqrt{\frac{l}{a\pi} + \frac{x^2}{4a^2}} - \frac{x}{2a}$, and then as the new ring must make the same number of revolutions, we substitute this value of n in the equation.

$x = \frac{l}{n\pi} - na$, l', x', being the new values of l and x.

$$\therefore n = \sqrt{\frac{l}{a\pi} + \frac{x^2}{4a^2}} - \frac{x}{2a} = \sqrt{\frac{80\times36}{1\times3{\cdot}14159} + \frac{40^2}{4}} - \frac{40}{2}$$

$$= \sqrt{\frac{2880}{3{\cdot}14159} + 400} - 20 = \sqrt{1316\,7332}, \text{ \&c.} - 20 = 36{\cdot}28, \text{ \&c.} - 20$$

$= 16{\cdot}28$, &c number of revolutions to two places of decimals. And by the second substitution,

$$x' = \frac{l'}{n\pi} - na = \frac{155\times36}{16{\cdot}28\times3{\cdot}14\,159} - 16{\cdot}28 = \frac{5580}{51{\cdot}1450} - 16{\cdot}28, \text{ \&c.}$$

$= 109{\cdot}09 - 16{\cdot}28$, &c. $= 92{\cdot}81$ inches nearly, the diameter of the new ring, which was required.

N. B.—If the new rope is of a different thickness, we have only in the last substitution to vary the value of a.

If you think the above worthy of a place in your pages, and it should meet the eye of any one who avails himself of its practical use, I shall be amply repaid for my trouble by his bearing in mind, that he is indebted to the assistance and well wishes of

A Country Curate.

April 15, 1830.

PROMOTION OF COMBUSTION BY MEANS OF EXHAUSTION.

Sir,—Perceiving in your Magazine, No. 356, p. 235, a statement copied from the *Liverpool Albion*, in which Messrs. Braithwaite and Ericsson are mentioned as having introduced a new principle of exhaustion by means of a fan-wheel, I beg to send you a description of three different methods which I employed to effect the same object in my patent steam-carriage, and which were made trial of during the month of May,

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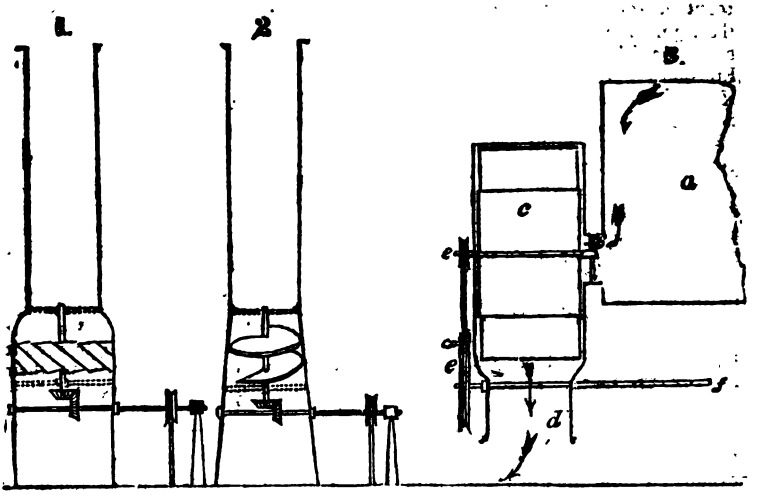

1829. The two first contrivances, as shown at figs. 1 and 2, were placed within the chimney itself. The first was a vane-wheel of a similar construction to the common ventilator; the second was formed of a single spirally-winding plate; and although they certainly produced an increased effect, were not found sufficiently powerful in their action. I therefore had constructed the apparatus as shown at fig. 3, which perfectly answered my expectations, producing a most intense heat, and which, in conjunction with the mode I adopted of causing the air to pass downwards through the fuel, had the effect of generating not only an abundance of steam, but also of preventing all smoke, and enabling me to dispense entirely with a chimney—indeed, so completely, that the gases produced by combustion were impelled in a strong current against the ground itself, owing to the flue being carried downwards, as shown in fig. 3.

Having been at considerable trouble and expense in alterations to prove the efficacy of these methods of exhaustion, and as it is my intention to continue their application to any steam-carriages I may construct in future, either for common roads or railways, I am induced to send you these particulars, not for the purpose of detracting in the slightest degree from the merit of Messrs. Braithwaite and Ericsson's improvements, which may possibly be quite different from those I have described, but merely of establishing my right to continue the employment of what I consider a very important step towards the perfection of locomotive-carriages, and as it may perhaps be the means of saving parties the useless expenditure of money in patenting contrivances which have not only been long since constructed, but publicly exhibited in the neighbourhood of London.

I am, Sir,
Your obedient servant,
W. H. James.

June 7, 1830.

References to fig. 3.

a. Boiler, composed of annular tubes, and capable of sustaining a pressure of 4000lbs. upon the square inch.

b. Flue leading from the boiler.

c. Fan-wheel enclosed in a wrought iron case.

d. Flue continued downwards from exhausting apparatus.

ee. Pulley-wheels in the proportion of 6 to 1.

f. Shaft connected with and kept in rapid motion by steam-engine.

Sir,—I observe in your most valuable and interesting Magazine an ac-

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count of some experiments made a short time ago, at Liverpool, with a boiler on Messrs. Braithwaite and Ericsson's exhausting principle. Knowing the character of your work to be that of admitting every thing which tends to elicit truth, and to give credit to those to whom it is due, I have to inform you that the same thing (exhausting or drawing the hot air or smoke from the fire by a fan or air-pump) has been done some ten or twelve years ago, both by Mr. Nevill, of Shad Thames, and Mr. Hague, of Cable Street. They applied the apparatus both to forcing and exhausting the smoke or hot air from the fire through the flues of the boiler. It was applied, in one instance, to a 10-horse steam-engine in Gravel Lane, and the smoke (they burnt coals) was exhausted from the flues of the boiler, and driven into the common sewer under ground instead of having a chimney. I have no interested motive in making known this circumstance more than that of wishing to see every ingenious man have justice done to him; and have no doubt that when Messrs. Braithwaite and Ericsson took out their patent they had not the slightest knowledge of the same principle having been applied before.

I am, Sir,
Yours, &c.

AN ENGINEER.

June 7, 1830.

THE RAILWAY SYSTEM—COG AND PLAIN RAILS.

Sir,—The scheme of a "mixed railway" (of cog and plain rails) was suggested several months ago by the letter, published in the *Liverpool Mercury*, of which I send you a copy. I hope that, according to the prefatory recommendation by the editors of that paper, you will give it a place in the "Mechanics' Magazine." Perhaps the method suggested by Mr. W. Bennett, in your 255th Number, of bringing the cogs of the locomotive-engine wheel to act upon the cog-railway, will, in some degree, obviate the difficulty mentioned in the extract, which I also send you, from a second letter, published in the same paper, by the writer of the first.

I am, Sir,
Yours, &c.

R.

Important Suggestion.

The writer of the following letter has pointed out an improvement, in our opinion so obvious, and of such vast importance, that we regret that he did not some time since suggest it to the Railway Committee. The hint may be so useful to the nation at large, that our contemporaries throughout the country would do well to give it all the additional publicity in their power.—*Editors of the Liverpool Mercury.*

To the Editors of the Liverpool Mercury.

Gentlemen,—Here is an improvement in the construction of railways, and in the adaptation of locomotive-engines to them, which is so obvious and so important, that I cannot conceive how it can have been overlooked, nor, if it has been perceived, why it has not been adopted. It consists in the mere addition to the outward edges of the rails on inclined planes of a *raised* flange or range of cogs, and of corresponding cogs on the power-wheels of the locomotive-engines at a proper *distance from the rim* of the wheels, to work in the interstices of the cogs on the rails. These little alterations would render fixed engines on railways quite unnecessary, and the necessity of deep cuttings and very high and long embankments would be very much lessened; for as the locomotive-engines would, with their loads, either ascend or descend considerable elevations or declivities, the inclined planes might be made steeper and shorter, with the farther advantage of greater length in the level part of the road. On this, as the rails would be without the raised cogs, and plain as now, and the cogs on the rails would not come into contact with them, the application and efficiency of the locomotive-engines would be exactly the same as on the railways hitherto constructed for them. If the Liverpool and Manchester Railway had been thus, what I will call a "mixed railway," instead of being composed of plain rails throughout, the fixed engine at the upper end of the tunnel would not have been in the least degree requisite, and the expense

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of fuel for it, of men to work it, of the ropes and other tackle attached to it, would have been saved; and the danger there is of the ropes breaking, and probably loss of lives, as well as the damage of whatever may be in the way of the loosened waggons descending with irresistible rapidity and force, would have been avoided; the inclined plane at Rainhill would have been much shorter—heavier loads might be dragged up it, and if not with greater speed (which, however, I think they would be) the greater length of level road would, upon the whole, have compensated for any delay which could be occasioned by the cogs and somewhat steeper ascent. On the Bolton Railway a charge is made for dragging up the planes of 8*d.* per ton, and of 6*d.* per ton for letting down, which would have been quite unnecessary had that railway been made on the mixed principle here suggested; and I have no doubt that by this the speed of ascending and descending would have been greater than is practicable by fixed engines and ropes.

Men of science being, I believe, generally whigs, I presume that most of those who reside within the sphere in which your paper circulates, are amongst your readers, and I hope that if there is any objection to the scheme of improvement above-mentioned, some of them will have the goodness to point it out through that medium by a reply to this letter. Unless I am mistaken in my view of the matter, the "mixed railway" will come into general use; and not only facilitate, but obviate all difficulty in the making railways for the general purposes of roads throughout the country.

I am, Sir,
Yours, &c.
T. H.

December 13, 1829.

P.S.—The grooves betwixt the cogs on the railway being made to slope a little outwards, they, as well as the other part of the rails on the inclined planes, will be kept clean by rain.

Extract from Second Letter.

I am, however, aware that there is some difficulty to overcome in giving the mixed railway the most perfect effect; and my motive in now addressing you on the subject is to point out this difficulty, still hoping for the furtherance of the scheme by the detail and discussion of it in your paper.

When a locomotive-engine, coming along the plain part of the railway, arrives at the range of cogs, it may happen that the cogs of the wheel will be so situated as to fall upon the cogs of the railway instead of the interstices; and the difficulty is to make the engine enter upon the cog-railway without any jolt or check, and without the necessity of stopping, or of its speed being much lessened. I entertain no doubt of this being accomplished by a proper formation and arrangement of the cogs on the wheels and those on the railway, and a gradual commencement of the latter; but of the most eligible mode that can be devised, I am far from confident. Should some of your readers, who are engineers or mechanics, give their best consideration to the matter, perhaps they may hit upon some invention for the purpose, which, under a patent, will amply remunerate them.

PHYSICAL ESSAYS.

No. 3.

On the Attraction of Cohesion, and Expansion of Bodies by Heat.

When a solid body, as, for instance, a rod of iron, has its temperature raised, it gradually increases in bulk. This expansion, even when produced by considerable thermometric elevations, is, in the generality of cases, small, and its exact degree difficultly appreciable. As a means of surmounting this difficulty, philosophers have invented *pyrometers*. Ferguson, Deluc, Ramsden, Lavoisier and Laplace, Smeaton, Dulong, and Petit, and other experimentalists, have furnished instruments of this kind. Some of them, as, for instance, that of Ferguson, are erroneous in principle; they ascertain the linear expansion only. Since bodies expand in every direction, and since in liquids and gases in consequence of their being confined, the expansion in breadth is converted into expansion in length, it is evident that the expansion of solids in both directions must be ascertained in order that we may obtain the total expansion, or its quantity of comparison with liquids and gases. Dulong and Petit "determined the absolute dilatations of iron, copper, and platinum, by intro-

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ducing cylindrical rods of these metals of known weight and density into the centre of an iron tube, and then filling it with mercury, and exposing it to determinate temperatures." By this method, the total expansion of the metals was ascertained, and the results were comparable with liquid and aerial expansions.

The temperature of the body having been raised to a certain point, a change of state is induced, and the body becomes liquid. Further additions of heat cause expansions of the liquid; but the rate is altered, being considerably increased. The temperature still rising, a second change of state ensues, and the body assumes the gaseous form.

Philosophers have generally attributed the increased ratio of expansion in solids and liquids by equal increments of temperature to the diminution of cohesive attraction.

Dr. Ure, in a paper published in the "Philosophical Transactions for 1818," observes, "I think it indeed highly probable, that every species of matter, both solid and liquid, follows an increasing rate in its enlargement by caloric. Each portion that enters a body must weaken the antagonist force—cohesion, and must therefore render more efficacious the operation of the next portion that is introduced. Let 1000 represent the cohesive attraction at the commencement, then after receiving one increment of caloric, it will become $1000 - 1 = 999$. Since the next unit of that divellent agent will have to combat only this diminished force, it will produce an effect greater than the first, in the proportion of 1000 to 999, and so on in continued progression."

If this opinion is correct, we may justly expect to find that the cohesion of a solid is less at high than at low temperatures, and that the expansions of different solids are inversely as their cohesive forces. Here it will be advantageous to consider the agencies of heat separately.

1st. When heat exists in a free or sensible state.

2nd. When heat is latent.

The great differences between the cohesion of the same body in different states, is owing to what is termed "the absorption of coloric;" as was satisfactorily proved by Dr. Black, and other experimentalists who have followed in his wake. Notwithstanding this, many writers have adduced these differences as proofs that thermometric elevations affects cohesive attractions. Dr. Ure, on the contrary, observes, "the new relation to heat which solids acquire by liquefaction, is derived from the absorption and intimate combination of a portion of that fluid, which *thus employing all its repulsive energies in subduing the stubborn force of cohesion*, ceases to have any thermometric tension, or to be perceptible to our senses."

Dr. Ure appears to me to err rather in the opposite extreme, by supposing that the cessation of thermometric tension is caused by cohesion. This supposition implies that water, for instance, has greater cohesive force at 212° F., at which temperature heat becomes latent, than at 32° F. and upwards. Again: water boils in vacuo at very reduced temperatures. "By condensing steam formed at this temperature (70° F.), and observing the quantity of heat which it communicated to a given weight of water, he (Mr. Watt) determined that its latent heat, instead of being only 955°, was between 1200° and 1300° (Henry's Chemistry, vol. 1. p. 106). We can hardly suppose that the cohesion of water is dependent upon barometrical pressures, much less that it is increased by their diminution. If, however, we allow that that force, which requires a greater counterbalancing force than another, is itself greater, it would follow from the above facts, if explained on Dr. Ure's principle, that the cohesion of water is greatest in vacuo. I am of opinion that the loss of thermometric tension by heat, and its entire change of properties, is occasioned by peculiarities in the calorific principle itself; and that the diminution of cohesion in the cases above stated, is not the cause but a resulting phenomenon.

Let us now turn our attention to the phenomena arising from the compounded agencies of cohesion and *thermometric* heat. That cohesion operates most powerfully in opposing the thermo-expansive force in solids,

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both before and after the bulk of the solid is increased, cannot be questioned. This shows that there is what is termed a sphere of cohesive attraction surrounding the atoms of matter. Hitherto I have considered the cohesion of different bodies as varying only in *degree*; now I must consider it as varying also in *extent*. Some bodies have strong cohesive forces in narrow limits: in other, the sphere is large, but the force small. Steel may be adduced as an instance of the first class, and caoutchouc of the second.

If we could ascertain that the expansion of a solid by unmodified calorific repulsion is equal for equal increments of temperature, and that heat possesses thermometric tension only in those cases where there is no change of state, we should be fully justified in concluding that the force of cohesion within its sphere is variable—being inversely as the distance either directly, or according to some power at present unknown. From the law of gaseous dilatation, I should be inclined to answer the first of the above points in the affirmative. I do not think that any uncertainty hangs over the second. To enter into the arguments on this point, arising from the phenomena of latent and specific heats, would lead me too far from my main subject; but one fact alone will set this question in its true light, and prove the operation of latent heat in cases where its presence has, perhaps, hardly been suspected.

"Take a thong of caoutchouc, two or three inches long, and a few lines in breadth and thickness; put it in warm water till it becomes quite pliant, then, holding it merely extended between the hands, bring the edge of it in contact with the lips, and observe the temperature (of the variations of which that part of the face is a very nice judge); then remove the thong a few lines from the lips, and stretch it forcibly, and bring it again in contact with the lips, and a very sensible increase of temperature will be perceived. Allow it to relax to its former state, and the temperature will be perceived immediately to sink. If we stretch the thong again, and then plunge it immediately into cold water, keeping it extended for a minute or more in the liquid, on letting go one end it will be found to have lost much of its contractile power; for it will not return to its former dimensions. But if we plunge it into warm water, it will begin to contract again, and soon return to its former figure and size. These experiments are of great importance, as they furnish a very palpable and convincing proof that ductility is owing to latent heat as well as fluidity: they afford a fine illustration of Dr. Black's theory of latent heat. We see clearly that the elasticity of caoutchouc, and the ductility of metals, are different cases of one and the same thing."—*Thompson's Chemistry*, vol. iv. p. 173. From this fact I draw these two conclusions:—1st. That heat becomes latent at other temperatures than those at which the liquid and aerial states are induced; and, secondly, that this heat affects the sphere of cohesive attraction. The second conclusion is the only one on which I shall here enlarge. The malleability of metals depends to a certain extent on the presence of latent heat. A piece of metal being exposed to blows of a hammer, or strokes of the die, becomes more dense and more brittle whilst heat is evolved. Here we see that the abstraction of heat impairs cohesive attraction, although the particles have approached near to the centre of their general cohesive sphere. A more striking and decisive case is afforded by some resinous bodies.

If a stick of sealing-wax be suspended longitudinally, and sufficient weights be suspended to it, its fracture will be effected without any previous perceptible lengthening of the stick. When heat is applied, the circumstances of the case are much altered. The mere weight of the stick becomes sufficient to effect its elongation, a considerable degree of which precedes fracture, which shows that the cohesive force is diminished, but its sphere enlarged.

It must not be concluded from the above observations, on the degree and extent of cohesive attraction, that they are inversely proportionate to each other. So many instances will readily occur to the mind of the reader to pre-

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vent his drawing this erroneous conclusion, that I need not adduce any.

In some cases the passage from the solid to the liquid state is instantaneous: an instance of this is afforded by ice. In other cases the change is gradual, and its various stages easily perceptible. Glass, wax, tallow, resins, and other similar bodies, exhibit instances of this kind. "In general, those solid bodies which crystallize or assume regular prismatic figures, have no interval between solidity and fluidity; while those that do not usually assume such shapes, have the property of appearing successively in all the intermediate states."* As an expression of facts, this quotation is true; but I should hesitate to conclude from it that crystallization is the cause of the phenomenon of immediate liquefaction: probably they are co-existent phenomena dependent on different causes. Parallel cases are furnished by some liquids, in which the attraction of crystallization cannot operate. Water, alcohol, and volatile oils, evaporate *spontaneously*, that is, at *all* temperatures: these phenomena are parallel to those of gradual liquefaction. On the other hand, "sulphuric acid and the fixed oils never begin to assume the form of vapour till they are raised to a certain temperature. Though left in open vessels, they lose no perceptible weight; neither does sulphuric acid lose any weight though kept ever so long in the temperature of boiling water."† These phenomena, I need hardly say, are parallel to those of immediate liquefaction. The liquid dilatations will now engage our attention.

Accurate experiment has proved that these are unequal for equal thermometric increments, although in many cases this inequality is barely perceptible. In general those liquids expand most equally, which boil at the highest temperatures.

The ordinary explanation of these facts, which considers cohesion as an attractive and sensible heat as a divellent agent, and these as the only agents in producing the phenomena, appears to me to be insufficient and unsatisfactory. The agency of latent or combined heat is inconsiderable; yet in this explanation is altogether overlooked. The fluid condition, in which the cohesion is greatly diminished, is unquestionably owing to latent heat, which, indeed, is often called "caloric of fluidity." "The absorption of caloric" (if an hypothetical mode of expression may be used) by liquids, at certain temperatures, effects a further change of state in which cohesion is wholly destroyed. The thermometric range included between these two points is variable, because of the inconstancy of the second point. Under mean barometrical pressure, water boils and vapourizes at 212°, alcohol at 173°, sulphuret of carbon at 116°. These, and all other liquids, boil at 124° lower, when in vacuo, according to Professor Robison: Dr. Black says, 140°. These effects of atmospheric pressure are curious. The cohesion of the fluid particles, above the vacuo points of vapourization, seems to depend upon atmospheric pressure. The same law governs the expansion below and above these points. Mr. Dalton says, "that the quantity of expansion (of all liquids) is as the square of the temperature from their respective freezing-points, or points of greatest density."* Dr. Young says, that the expansion of water may be represented by this formula,

$$\cdot 0000022t^2 - \cdot 00000000435t^3.\dagger$$

M. Biot. (Traité de Physique, tom. i.) has ascertained that the dilatation of liquids may be represented by an expression of this form

$$\delta t = at + bt^2 + ct^3.\ddagger$$

(In this formula t denotes the temperature in degrees of the mercurial thermometer: a b e constant co-efficients which depend on the nature of the liquid; and δt the true dilatation for the vol. 1.0 from the temperature of melting ice.) Although the pressure of the superincumbent air exerts

* Thompson's System of Chemistry, vol. i. p. 46.
† Ibid. vol. i. p. 57.

* Henry's Elements of Chemistry, vol. i. p. 81. and Ure's Dictionary. Art. Caloric.
† Young's Lectures on Natural Philosophy, ii. 392.
‡ Ure's Dictionary. Art. Caloric.

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so marked an influence upon the boiling points of liquids, it has but little, if any, effect upon their rate of expansion.

"Mr. Canton found, in a set of experiments which he made on the subject, that when liquids were freed from the pressure of the atmosphere, they underwent a certain expansion, and were proportionally compressed when the pressure of the atmosphere was doubled."* This expansion and compression are very small. We need not be surprised at this, if we bear in mind, that the weight of the atmosphere, being only 15 pounds to the square inch, is trifling in comparison with the force of expansion.

From the above and some other facts, I think it probable, that though atmospheric pressure continues the liquid state at higher temperatures than those of vacuo ebullition, it does not affect the rate of expansion.

As the increase of temperature produces expansion, so its diminution is followed by contraction. The expansion is directly owing to heat, the contraction only indirectly. Increase of temperature brings into operation an expansive force as an approach to the quiescent force of cohesion: diminution of temperature does not generate a contractile force, in which case it would act directly, but removes the antagonist force to cohesion. These observations tend to place certain anomalous phenomena in their true light. When heated water is cooled, it gradually contracts, and if the reduction of temperature be sufficiently continued, finds its maximum density at about 39° Fahrenh. All this admits of an easy explanation on the above principles. A remarkable reversion of effect is consequent upon a farther reduction of temperature. A gradual expansion takes place, and continues down to 32° Fahrenh. at which temperature the water becomes solid. The rate of expansion is precisely the same on both sides of the maximum point. This similarity of rate argues strongly in favour of a similarity of course: yet it is difficult to conceive how either heat or cohesion can operate as divellent agents. Dr. Ure has explained these "irregularities" by supposing that the atoms revolve on their axes, and possess polarity. We know too little respecting the intestine or atomic motions of matter to speculate on them with advantage.

Objections to the axual revolutions of atoms might be drawn from the atomic constitution of compound matter. The *modus operandi* of heat, the regularity and similarity of the expansion on both sides of the maximum point, and the existence of the point itself, are unexplained by Dr. Ure's theory. If we prefer plain, sober truth to the ingenious flights of imagination, we shall reject all the explanations hitherto offered, and confess that we are unable to solve the problem.

Having already extended this essay to too great a length, I must omit the consideration of a few interesting facts which I had marked for examination.

The theory of Boscovich must now engage our attention.

Sir Isaac Newton supposed the ultimate atoms of matter to be "solid, massy, hard, impenetrable, and moveable particles." Boscovich, on the other hand, excluding solid atoms altogether, considered that "matter is composed of a definite number of mathematical points, endowed with certain powers of attraction and repulsion." A mathematical point is defined to be that "which has no parts or magnitude." Here we are thrown back upon the question of the infinite divisibility of matter. For very convincing arguments in favour of the opinion advocated in the first of these essays, and with which I was unacquainted at the time I commenced this series, I refer the reader to Dr. Turner's "Elements of Chemistry" (*Nitrogen*). If we have never yet succeeded in obtaining matter in a state of such minute division that the magnitude of the atoms was destroyed; if the limits to division originate not in the imperfection of our instruments, but in the forces which bind matter; if the fundamental principle of the "amended" *theory* of Boscovich is not essential to a satisfactory

* Thompson's Chemistry, vol. iii. p. 77. et seq.

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exolanation of atomic phenomena, and if the "Newtonian *hypothesis*" is equally applicable, surely we have not the slightest ground for supposing such an atomic constitution of matter as is assumed by Boscovich.

(To be continued.)

PARTIAL OPENING OF THE LIVERPOOL AND MANCHESTER RAILWAY.

(From the Manchester Mercury.)

In consequence of its having been announced, for a week or two in the newspapers, that the Directors of the Liverpool and Manchester Railway intended, on Monday last, to proceed in a carriage, propelled by a locomotive-engine, from Liverpool along the whole length of the line, to hold their first board in Manchester, a great concourse of people assembled. At five minutes past eleven the Directors and some of their friends, with the resident engineers, in all about forty, arrived in two carriages. The engine used on the occasion was a new one, constructed by Messrs. Stephenson, and designated the Arrow. In addition to its own weight, with its appendages for the supply of water, &c. 7 tons, it drew behind it seven waggons; laden ith wstones, weighing 27 tons, behind these were stationed two coaches, containing the Directors and their friends, weighing 5 tons more; making a total weight of 39 tons. With this weight the engine compassed the distance (rather more than thirty miles) *in two hours and one minute*, exclusive of 19 minutes taken up in stoppages for the necessary supply of fuel and water.

(From the Liverpool Mercury.)

The Directors (on their return to Liverpool) filled with their friends two coaches, which darted through the dense mass of individuals who thronged the railway, passed over Chat Moss at the rate of about 22 miles an hour, and arrived at Edgehill, Liverpool (after deducting seven minutes for stoppages) *in one hour and thirty minutes*. The average speed on the return from Manchester was 20 miles an hour, and in passing over Chat Moss the carriages proceeded, for a time, at the rate of 27 miles!

(From the Liverpool Times.)

The steam-carriages vary in their size and plan; some have two bodies, and others three; some are intended to accommodate four persons in each body, and others six; and some have a central compartment, which will contain six persons, with seats before and behind, and two other compartments are in front and one in the rear, each of them resembling a post-chaise, with windows in front, and containing only three persons. The seats, which accommodate three persons each, are, at least, twice as wide as a four-inside stage-coach so as to allow the same space for three as is now allotted to four. Between the sittings is a rest for the arms, and each passenger has a cushion to himself: there is also a little projection against which he may rest his head; and the backs are padded and covered with fine cloth, like a private carriage, so that the passenger may sit and sleep with as much comfort and luxury as if he were in an easy-chair or on a sofa. The external appearance of the coaches is nearly equal to that of a handsome carriage. There are no outside passengers on these vehicles, and they carry no luggage; but for the accommodation of both, there is a different kind of carriage, about as high as a common cart, and having four or six rows of seats, under which there are receptacles for the luggage. The passengers by these conveyances will be not nearly so elevated nor so much exposed to the danger of falling off as the outside passengers on a stage-coach. It is probable that one or more of the latter vehicles will always accompany the coaches. There are also light waggons prepared for the conveyance of bales of cotton—an article of which the quantity transported will be immense.

NEW MECHANICAL QUESTIONS.

1

A merchant each year increases his capital by an n^{th} part of itself, except an expenditure of £ a, per annum, and at the end of m years, he is worth £ b. Find his original capital, and

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give an example in numbers when $n=5$, $a=400$, $m=15$, and $b=12{,}000$ *

IVER MACKIVER.

2

A. bets B. 5 to 1, that in drawing 4 cards from a pack consisting of 52, that he (B) will have two or more cards of the same suit. Find the precise odds. Determine also if it would alter the chances if the pack consisted only of 36 cards.

G. S.

3

A glass tube 40 inches long, is half filled with common water, and then is inverted in a vessel of water, as in the Torrecellian experiment, so that the 20 inches of air rises to the top; to find at what height the water will remain suspended in the tube, the height of the mercury in the barometer at the same time being 30 inches.

KINCLAVEN.

4

A circle and a straight line without it being given: it is required to find a point in the given line, so that if a perpendicular be drawn from it to meet the circumference in two points, the rectangle contained by the external and internal segments may be equal to a given space. Determine also the limits of the problem.

DUNDEE.

5

If from any point without a circle any two secants be drawn, and the opposite points of the intersection be joined, these two lines will intersect one another in a point, the locus of which will be in a straight line, given in position and magnitude. Demonstration required.

THOMAS HUGHES.

6

Bisect a trapezium by a straight line drawn from one of its angular points, by means of straight lines drawn within the figure.

THOMAS HUGHES.

* The object of this question seems to be to elicit an illustration of the superior facility of logarithmic calculations as compared with common arithmetic. The tables of Mr. Woolgar, in our last supplementary number, will be of great assistance in its solution.—ED. M. M.

Fire-Engines.—Perhaps Mr. Baddeley, who appears to be well acquainted with the subject will be so obliging as to say whether the mixing the air-vessels of our more powerful fire-engines is absorbed by the water to any extent, and if there are means provided to recruit it, as is done in the improved Montgolfier's ram.

B. C.

Substitute for Hops.—The marsh trefoil is employed on the Continent for this purpose, and it is said was formerly used in this country. The plant is of easy culture in moist soils. All the plants of the same natural order, *Gentiana*, might be used in the same manner.—*London's Cottage Gardening.*

Beer Flavour.—In Germany, the dried roots of *Gentiana arbenum*, common in hedges, are sliced, enclosed in a linen bag, and suspended in the beer-cask by the brewers, to prevent, it is said, the beer from turning sour, and to give it the odour of cloves.—*Ibid.*

INTERIM NOTICES.

The Editor of *The British Co-operator* informs us, that the article on the "Reduction in the Cost of Printing-Apparatus," which we reprinted in our 356th Number from that work, "*was not copied* from the American *Free Enquirer*, but, on the contrary, was published by him as he received it from Josiah Warren, of Cincinnati." "The communication was printed with the new types made in the manner described by the inventor;" and should any person be desirous of seeing letter as a first specimen of the beauty of the types, the Editor of the *Co-operator*, will have much pleasure in showing it to them.

Mr. W. Turner is informed that every Part issued from this office has a distinctive wrapper filled with advertisements; but that booksellers occasionally make up their overstanding weekly Numbers into Parts with plain covers—which is no doubt his case. Venders may, at all times, have separate copies of the genuine wrapper for nothing on application to our office.

X. Y. Z. will perceive, on reflection, the impropriety of asking us to publish on anonymous authority the encomium he has sent us. It may be deserved; but as we have not seen the work, we cannot be sure that it is.

Communications received from J. W. D.—Mr. Utting—Mr. Wentworth—Mr. Baddeley—A. P.—Mr. Thomas—Mr. Barnard—Mr. Foord—W. S.—Mr. Matthews—A Practical Engineer—A Half-Pay Officer.

Improvements in Ribbed Groins.—In fig. 1 of the illustrations of the article on this subject in last Number, the lines which cross the diagonal rib in the quarter B, as well as those on *either side* of the diagonal rib in D, diviate considerably from the perpendicular, in which direction they ought to have been engraved. The error is important, as it is one of the principal objects in these sort of groins, that any point on the one side of any rib should be of the same height as a point perpendicular to it on the other side. Fig. 13, to which a reference is made, has been accidentally left out. In fig. 15, the letter B, which is referred to in the description of fig 9, is omitted. It ought to be in the quarter opposed to the one marked A.—J. J.

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Mechanics' Magazine,

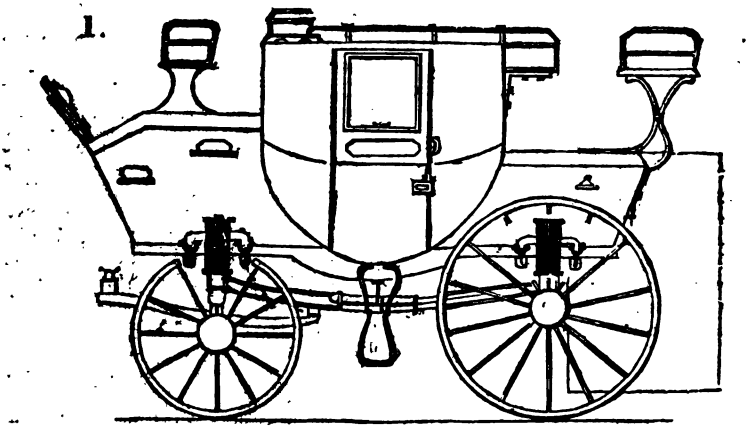
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

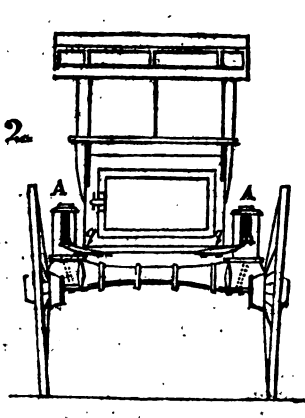
No. 359.] SATURDAY, JUNE 26, 1830. [Price 3d.

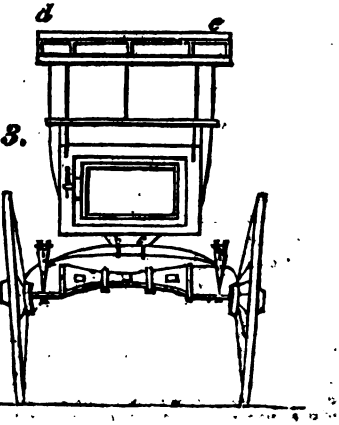
"Yes, we shall conquer! All these dangers past
Will serve but to enrich the future story."

JEPHSON.

LACY'S NEW PATENT APPARATUS FOR SUSPENDING CARRIAGE-BODIES.







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NEW PATENT APPARATUS TO SUSPEND CARRIAGE-BODIES. INVENTED BY MR. HENRY CHARLES LACY, OF MANCHESTER.

(Abridged from a Pamphlet published by the Patentee.)

The principal cause of the many lamentable accidents which are daily happening from the overturning of stage-coaches, is the defective construction of the carriages, which are totally unsuited to the speed at which they are now usually driven. It is not the wish of the patentee to denounce any particular mode of construction, but he thinks he shall be able to show that all the kinds of carriages used in Great Britain possess great and serious defects. To begin with stage-coaches on the most approved construction, namely, those on what are called telegraph-springs. Fig. 3, is a view of one on this principle. The body is attached to four body-springs exactly *under the centre of its width*. From *b* to *c* is the only part of the carriage-body which comes in contact with and receives immediate support from the springs. Now, it must be clear, that weight placed so far above and outside of *b* and *c* as at *d* and *e*, must act with considerable leverage on the body-springs; and that, in fact, as long as these springs are elastic, there is at every step an oscillation from side to side of the upper part of the coach, which increases with the speed, so as frequently to become a dangerous swing. When travelling on the side of a convex road, the body of a coach on this principle stands at a much greater angle of inclination to the road than the under-carriage does, so that the slightest contact against even a stone at the higher side endangers the safety of the coach; and it not unfrequently happens that coaches are upset by the wheels on one side sinking but a very little into a soft place. A mail-coach is still more liable than the stage-coach to be upset. The front hangs in the same manner as a telegraph-coach, but the hind-part is lamentably deficient, having only one cross-spring to resist its oscillations instead of two. The two wing-springs, which are attached to the body, and ride upon the hinder or balance-spring (so called), are quite defective in principle. They allow oscillation to a very great extent; and if a mail-coach were laden as much as a stage-coach usually is, it could not travel fast round a corner or down a hill without upsetting; although the load is so much less at the top, no carriages take such swings or oscillations, as every one accustomed to travelling well knows.

The invention by which the patentee proposes to obviate these risks, and to obtain besides, superior ease to the passengers—a considerable saving of weight—lightness of draught (independent of the saving of weight)—and durability—may be advantageously applied to carriages of all descriptions: but as stage-coaches travel more rapidly, and carry greater weights than private carriages, a drawing and description of the invention is given as applied to a stage-coach.

Fig. 1, exhibits a side-elevation of a coach, the body of which is suspended on the improved principle. Fig. 2, is an elevation of the same as viewed from behind, and together with fig. 1, represents the position of the cylindrical cases, AA, upon the under-carriage. Fig. 4, is a section, on a large scale, of one of these cylindrical cases. A base-plate *b* of wrought-iron attaches the case firmly to the under-carriage on the hind-axle bed, just within the wheels, and on the ends of the spring-bed in front. In the centre of each base-plate is a conical hole, through which a guide pillar of wrought-iron *d*, having a conical head to fit the hole in the plate, is passed before the base-plate is fixed on. The plates with the guide pillars may now be considered as attached to and forming parts of the under-carriage. A circular groove *gg* in the base-plate receives the bottom of the wrought-iron cylinder *aa*. The cylinder being placed in the groove, spiral springs *p* are put within it, coiled in opposite directions to prevent their entangling. For perspicuity's sake, only one of these springs is drawn, but three or four, one within the other, are generally used. On these springs rests a circular gun-metal plate or disc *e*, rather smaller in diameter than the inside of the cylinder. The disc is perforated in the centre, and has on

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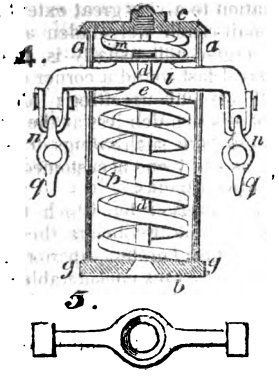

its under-side a socket to ensure its vertical motion in sliding up and down the guide-pillar *d*, and on its upper-side a convexity or semi-ball. There is a bonnet or cover of metal *c* with a circular groove to receive the top of the cylinder; and it has a hole in the centre through which the top of the pillar passes, on which a nut is screwed to secure together the cylinder, the base-plate, and the bonnet, forming a firm box, easily accessible, with a strong pillar coming up through its centre—through the inside of the springs—through the plate with its socket and convexity—and through the joint or shackle-bar *l*, made of wrought-iron. The form of this shackle-bar will be better understood by reference to fig. 5, which is a side-view of its under-side, showing a circular aperture through the centre, and a cavity to fit on the convexity of the plate *e*. The shackle-bar passes through slits or chase-mortices in the sides of the cylinder, occupying about two-thirds of the length of the cylinder, from the top downwards; and which slits or chase-mortices being somewhat broader than the shackle-bar is thick, allow it to pass freely up and down. The ends of the shackle-bar project beyond the sides of the cylinder sufficiently to prevent the joints or shackles *nn* and the arms *gg* from touching it in their utmost range of motion. The arms *gg* are of wrought-iron, and made fast to the body of the carriage, and connected by joints, holes, or shackles, in the ordinary way to the joint or shackle-bar. In fig. 4, *m* is a recoil-spring, the use of which is to give pressure to the springs when the carriage is lightly laden. It rests upon a plate, having a socket on its upper-side, and its under-side resting on the shackle-bar. The iron-arms *gg* being made fast to the body of the carriage, and attached, as before described, the weight of the body is thereby thrown upon the joint or shackle-bars, the concave sides of which resting upon the convexities on the upper-sides of the gun-metal plates, the latter are forced down upon and compress the springs beneath them. The convexity of the plate and the concavity of the shackle-bar form a sort of bolt and socket-joint, which allows one extremity of the shackle-bar to be depressed below the other without materially affecting the equality of the pressure on the springs.

It will be evident from the description now given, that the springs do not form the attachment of the body to the under-carriage, as they are not fastened to either, but are merely dropped into the cases, and serve as elastic supports or bearings, having a vertical action only. The attachment is by the pillar, and the sliding-plate and socket with its shackle-bar fastened by the shackles to the arms coming from the body. The points of suspension instead of being, as in ordinary stage-coaches, beneath the *centre* of the body, are all on the *outside* of the body—so that the weight does not act with any leverage on the springs, and the springs themselves having only a definite vertical action, will not allow of any rolling motion. Consequently, a carriage of this description cannot, like an ordinary mail or stage-coach, be overturned by its own motion; and the chances of oversetting by turning a corner or driving on the side of a convex road are very greatly diminished, as the body must at all times be nearly parallel with the under-carriage. In carriages on the old construction, the springs themselves form the means of attaching the body to the under-carriage; so that when a spring breaks, the body loses not only its elastic support, but its attachment to the under-carriage at that corner. Now, in the

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improved apparatus, if a spring should break, the body would only fall the space of one interstice, or about three-fourths of an inch; and it would still be on an elastic support even if there were only one spring in each box, for there would still be the other three in the same box standing on their own bases to sustain the body, so that the breaking of a spring would not so affect the carriage as to require any stoppage.

The absence of rolling or oscillation is attended with another advantage on the score of safety. The danger of breaking an axle, or any of the under-works of the carriage, is considerably reduced from the weights being much more fairly distributed on all the wheels, and never thrown from side to side. The new apparatus also takes up much less room, and therefore admits of larger boots, which contribute to bring the load nearer the ground. For example, the hinder-boot may be extended to the dotted line in fig. 1, as there is neither body nor carriage-spring in the way.

The *superior ease* to the passengers claimed for this carriage arises from this, that instead of cumbrous masses of steel, short and stiff, the strongest spring the patentee uses is composed of a bar upwards of seven feet long, and only about half an inch in diameter. The slightest obstacle calls such a spring into action; and, indeed, if the carriage passed over a boarded and carpeted floor empty, and at a foot's pace, the springs would act.

Next, as to the *saving of weight*. The springs and necessary fastenings for a four-horse stage-coach, on the old principle, weigh full 360lbs.; many weigh much more. In the new mode the cylinders, springs—indeed, all belonging to them—for fastening and bringing the weight of the body to bear upon them, do not weigh more than 140lbs. for the same description of conveyance.

Ease of draught, or, as the coachmen term it, lightness of *following*, will be obtained by the body; and its load being preserved in a straighter course forward, and the springs lending their aid at such times as other springs would not act at all: for example, on smooth roads, the inequalities of which are insufficient to call into action the strong and stiff springs of the old construction.

As to the point of *durability*, the patentee admits that the advantage is as yet theoretical; but as all practice has shown that the application of springs to a carriage conduces to its durability, he thinks it fair to argue that as there is no rolling with the new apparatus, as the play of the springs is quite perpendicular, and as they act with uniform ease, free from all sudden jerks and throws, the chances of durability must be proportionally much greater.

The patentee admits that private carriages, and such as are hung on C or whip-springs, are not so liable to be overturned as stage and mail coaches, not being subject to the *same kind* of oscillation, as carriages which have the points of suspension under the centre of the body. But they are still liable to a very great *lateral* sway; which is not only injurious to the draught, but exceedingly unpleasant to the passenger. The additional security which is afforded by the manner of hanging such carriage-bodies, is purchased at a monstrous increase of the weight of the under-carriage and springs, as well as of its wear and tear. A common chariot, made to carry five persons, weighs as much as most stage-coaches do that are made to carry fifteen or seventeen persons and their luggage; and, notwithstanding the extra weight of the under-carriage of a chariot, from the many contrivances that are introduced to stay and strengthen it, yet it is not near so strong as that of a stage-coach.

It is true, that the application of *under-springs* does insulate from shocks the heavy frame-work which C, or whip-springs necessarily require for their support; but the advantage which under-springs afford in this way, are found in practice to be attended with many countervailing inconveniences.

Now, by the adoption of the new apparatus, the heavy frame-work and the C springs are entirely dispensed with; and the substituted under-carriage being of the lightest and simplest construction, that part of the weight which has to pass over all in-

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regularities is not more (though it constitutes the whole under-carriage) than that part which is so circumstanced, in the case of carriages furnished with *under-springs*.

FIRE-ESCAPES.

We have received several additional communications on the subject of fire-escapes, and as we cannot immediately find room for them entire, perhaps the several writers will be satisfied by the following brief exposition of their views.

1. Mr. Barnard regrets the failure of the Society for Preventing Loss of Life by Fire; and very justly remarks, "if the society proceed to try experiments without consulting persons who have a good knowledge of mechanics, both theoretical and practical, they may squander away sums to any amount they are likely to receive, before they bring even *one* machine to perfection—as many a ruined, and half ruined inventor could inform them." Mr. Barnard then proceeds to observe, "I do not think there has been any thing (in the way of fire-escape) offered to the public superior to ladders: the fault is, they are not sufficiently numerous,* and that there are not proper persons in sufficient numbers stationed in suitable places to apply them when wanted."—"I would suggest," continues Mr. B., "that the cheapest way for the society to be properly effectual, would be—to place a sufficient number of fire-ladders in a district, with proper persons to attend them."—"This experiment would cost *nothing* more than the wages of the persons employed."—"If a fire occurred in any district so provided, its use would be practically shown; and if any death by fire should ensue in places *not* so provided, it would doubtless excite a strong desire in the inhabitants to be furnished with similar preventives—when they reflect that such calamity could not have happened in the society's district."†

Mr. Barnard next proceeds to enumerate several modes of retreat which may be likely to offer where persons are unprovided with a fire-escape; and at the same time very properly suggests, the propriety of every householder being furnished with some simple escape in constant readiness. Each of the expedients enumerated by Mr. Barnard has, however, been already described in our Magazine (some of them more than once), and will be found under the head "Fire-escape" in our past volumes. We shall, therefore, only subjoin the concluding paragraph of Mr. Barnard's communication.

"Perhaps there is no reason to despair of yet seeing much good effected by the Society for Preventing Loss of Life by Fire. Societies, like individuals, require *experience*, and are benefited by it."*—"There may be many skilful individuals in the society from whose exertions much may be expected. I would remind them of a sentiment lately expressed in Parliament to the effect—let a bill be introduced, and it may be rejected; introduce it a second time, and it may be rejected again; but persevere still, and if it is a measure evidently useful, depend upon it it will ultimately succeed."

2. Mr. W. Gibson has favoured us with a description of a fire-escape invented by Mr. Blakey.† This escape consists of a mast in three parts, mounted upon a low truck; the masts are raised by a winch, a rope from which passes under the heels of the two upper portions of the mast; the top-mast carries a pulley, by means of which a cot or cradle may be raised to the window of a house. This machine, in some respects, resembles the patent portable derrick of Mr. Gregory, described at page 213, vol. xi.; to which, however, upon the whole, it is very much inferior.

3. S. E. G., of Windsor, sends us a plan of an escape which he considers

* This is an error; *ladders are sufficiently numerous*. See vol. xi. p. 357.

† The course here suggested for the society's proceeding is precisely the same as our intelligent correspondent, Mr. Baddeley, has been all along endeavouring to press on their attention. See vol. xi. p. 358.

* Dear bought experience is said to be best; but GOLD may be bought *too dear*.

† The inventor of an improved anchor-stopper described at p. 407, vol. vi.

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simpler and more easy of general application than any we have yet published. It consists of a pulley at the end of an iron arm inserted into the wall below the window-sill; by means of this pulley a cradle can be raised for the reception of any person requiring escape. Many of our readers will, no doubt, immediately recognise this as an old contrivance; in some cases where this plan has been adopted, the pulley has been placed *above* the window, which enables the cradle to be drawn up much closer to the window than in the former case. Mr. Gregory has one or two escapes upon much the same principle, but materially improved. There are, however, many circumstances which greatly limit the usefulness of this form of apparatus, which it is needless to dwell upon at present.

MR. GILMAN'S STEAM-APPARATUS.

Sir,—Learning by accident that a controversy is raging relative to an apparatus constructed by Mr. Gilman in 1826, for the purpose of effecting combustion under pressure, and forcing the gases, &c. arising therefrom into the water to be evaporated; I beg leave to state that I was engaged with others in fitting up and superintending, during great part of the year 1826 and part of 1827, the apparatus, which is described in the 330th Number of the "Mechanics' Magazine," for the purpose of illustrating the object for which such apparatus was constructed; that, to the best of my recollection, eight of the much disputed bolts were one inch and one-eighth in diameter, and the remaining four were one inch and five-eighths; that the joints were *all* turned and grooved, and rendered perfect by means of copper-wire; and that after the effect of the expansion of the internal cylinder was corrected, such joints were perfectly *sound* at pressures of upwards of *two* hundred pounds per inch. Coke was used for fuel, and two blowing-cylinders were employed to supply the fire with air. I shall confine myself, Sir, to this brief statement, which I have no objection to verify by affidavit were it necessary, as I conceive it is all that is needful to prove the object contemplated in constructing the apparatus, and which of course proves that such object existed at least as early as the month of May, 1826.

I am, Sir,

Your obedient servant,

ROBERT BROWN.

17, *King Street, Commercial Road, June* 22, 1830.

PLAN TO RELIEVE LONDON FROM SMOKE.

Sir,—It is rather singular, that at a time when invention is with its mighty arm felling every obstacle before it, such a monster as London smoke should be left unsubdued—hovering over the metropolis to the woe of the asthmatic and the consumptive; blasting the works of architecture; and, to the despair of astronomers, veiling the heavens from their sight. I propose, Sir, to strangle this monster in the place of his birth. My plan is as follows:—Let threads of asbestos be suspended in chimneys about a quarter of an inch from each other, and let water be continually gliding down each thread. You will find that the smoke on striking those wet threads will be condensed, and carried down by the gliding water into a pipe or a receiver, so that there will not be a single atom of smoke escaping through the top of the chimney. A sufficient quantity of water could be forced up in five minutes to supply the threads for a whole day. Wires might be adopted in the room of threads; but there should be two wires touching each other, to cause a capillary attraction to retain the water gliding down. At copper-works tiles should be fixed in the stacks vertically, about a quarter of an inch from each other, and they should have small grooves on each side to distribute the gliding water to every part regularly. The whole length of the stacks should be filled with those tiles. By this simple means the poisonous

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smoke of copper-works would be completely done away with.

I am, Sir,
Your humble servant,
D. THOMAS.

Surrey Coffee House,
June 10, 1830.

REVIEW OF PAPERS ON FLYING. BY MR. JOHN HARRISON.

(Continued from No. 357.)

It was proposed in your 357th Number to examine what sized vanes are adapted to carry 300lbs. at a velocity of 36 feet per second (the velocity fixed by W. C.), and also the power that will be required to produce such velocity.

It will be better that the wheels contain only four vanes each (as shown by the front sketch, No. 240), and as the effect of the two descending vanes in each wheel, at all angles of position, is constantly as the squares of their respective distances from the perpendicular, it is evident that the amount of the resistance against both is continually equal to the maximum resistance against one—whence the effect of both wheels is only equal to the full effect upon two vanes. To get the area,

sq. ft. sq. ft. lbs. lbs. sq. ft. sq. ft.
As $36^2 : 106^2 :: 1 : 7{\cdot}7162$, and as $20 : 30 :: 7{\cdot}7162 : 115{\cdot}74$ = the area of two vanes, or 58 square feet area of each vane.

Now, respecting vanes of this size, there needs no comment, they being altogether unsuitable to the rapidity of the motion: in fact, if the wheel-arms were not of a great radius, their centrifugal force must be so great as to require them to be so strong and heavy as to frustrate their intention. And for the force (which is inversely as the motion) we have,

feet feet lbs. lbs.
As 2·5 : 36 :: 300 : 4320

which is the force required to be incessantly exerted on the handle in every part of its circuit, and must necessarily move at the rate of 2½ feet per second to sustain 300lbs. in the air. Nor is this all. The friction and the resistance of the vanes and arms, not only in ascending, but in all those parts of their revolution where they are not effective, are not included in this computation: if, therefore, one-eighth more be allowed for these, we shall have 4860lbs. acting through a space of 2½ feet per second, as the power required to render such a machine effective for carrying a single man.

Doubtless, vanes of three feet square are as large as can be admitted in such a machine. These placed at the ends of arms of 12 feet radius, might possibly sustain the great centrifugal force generated by their rapid motion: and as it may afford amusement to some readers, I will compute the velocity such vanes would require to sustain the same weight, and also the power necessary to give such motion.

		sq. ft.		
Area of vane, as above		58	.. log.	1·76343
Reduced area	3×3 =	9	.. ½	95424
Proportion of the areas			.....	80919
Proportion of velocities and motive-powers			.....	40459
Velocity in feet per second, as above		36	.. log.	1·55630
Required velocity, as adapted to the reduced area of the vanes		91·388	.....	1·96089
Motive-power, as above		4860lbs.	.. log.	3·68664
				40459
Power required with the increased velocity		12338lbs.	.. ..	4·09123

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I must now dismiss W. C., but not without rendering him those compliments that are due to him for the great ingenuity of his aerial carriage, and the justness of some of his observations, which render his productions by no means destitute of interest, notwithstanding some extravagant fancies, and although he has completely failed in the main point. I cannot, however, help conceiving some doubt respecting the regular opening and closing of the flaps. The great centrifugal force occasioned by so rapid a revolution of the vanes, and the position of those flaps in moving through the air in some part of their circuit, will apparently prevent them from acting in the manner intended.

(To be continued.)

LARGEST STONE-ARCH IN THE WORLD.

Sir,—In your 356th Number it is asserted that the middle-arch of New London Bridge is the largest in the world. I beg leave to contradict this statement. At Brioude, in France, there is a bridge over the River Allier, of one arch, 180 feet span, supposed to have been built by the Romans. It is not above 18 feet in width, I believe; and the height, from the spring of the arch to the crown, is about 70 feet. There is now building also at Chester, over the River Dee, a bridge of one arch, 200 feet span and 50 feet high, from a design by the late Mr. Harrison, of Chester.

Though neither of these bridges is half so wide as the New London, yet it will be seen they exceed in span, by 30 and 50 feet respectively, its widest arch.

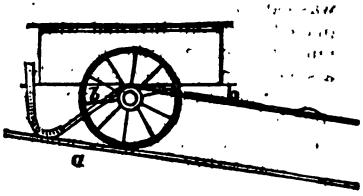
Yours, &c.

A Lover of Large Arches.

June 4, 1830.

P. S.—I believe the middle-arch of Southwark Bridge is the largest of any kind in the world; and I think a row under all the bridges of London presents nearly the finest sight in the metropolis to the eye of an architect.

IMPROVED CART-DRAG.



Sir,—The above sketch is intended to represent a plan which I have applied to my cart for the purpose of dragging down hills. The plan is so very simple, that it scarcely wants any explanation. *a*, is a strong, wide iron shoe, or drag, turned rounding, at one end of which is a bar fixed to the axle of the cart at *b*; and at the other end is also a bar fixed so as to move, which is attached to the hind-part of the cart by a pin with holes to raise it higher or lower at pleasure. When the drag is fixed on the top of a hill, the fore-pin of the cart is taken out, and the fore-part of the cart lifted up a little, to throw the weight on the drag behind. When down over the hill the pin is put in the fore-part of the cart, and the drag taken up a few pin-holes, to clear it from the ground. Should you think this worth a place in your invaluable work, perhaps it may be of some service to some of your numerous readers and correspondents.

I am, Sir,
Your obliged humble servant,
John Sims.

Pwllheli, North Wales,
May 12, 1830.

EFFECT OF ODORIFEROUS EFFLUVIA ON INSECTS.

Sir,—An experiment which I made only a few days back so clearly illustrated how very obnoxious the odour of such simple perfumes as camphor, cedar shavings, dried lavender flowers, &c. is to insects, that I take the liberty of troubling you with the particulars of it for insertion in your valuable Magazine; it will show how useful such preservatives must be in every wardrobe and cabinet.

An insect, a species of gnat, the body of a pale pea-green colour, and its extreme measure not exceeding

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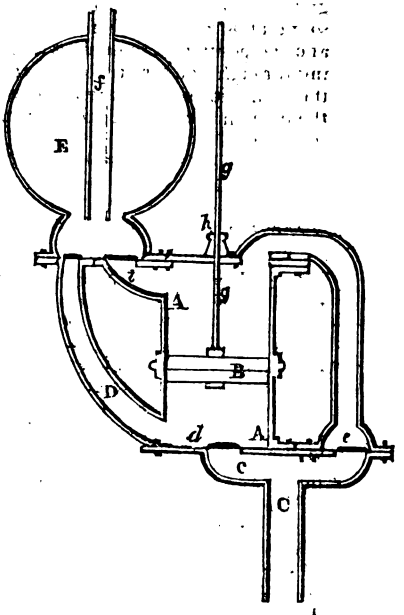
three quarters of an inch in length, was caught late in the evening, and placed under an inverted wine-glass. On the morning of the day following, a small slip of paper was folded up, one minim of essential oil of lavender dropped upon it, and then immediately placed under the wine-glass. The insect after creeping about for a short time the previous evening had settled on the roof of the inverted glass, where it remained, unmindful of the glass being disturbed till a minute or two had elapsed after the introduction of the essential oil. It now commenced drawing its feelers alternately between its fore-legs with a momentary increase of rapidity; it next moved about the upper part of the glass; it soon grew extremely uneasy, moving its head quickly towards and from the glass. In about ten minutes it partially descended the side and walked round, but in a little while longer it became much irritated, running to the bottom, fluttering its wings, pushing itself backwards, and then, as if revived by immersion in a stratum of purer air, it would attempt to re-ascend the side of the glass. It was curious to observe that every fresh attempt became more and more circumscribed, till at length it remained in great agitation at the bottom, sometimes crawling over the scented paper, but soon falling down much enfeebled, and constantly most overcome when in the vicinity of the oiled portion of the paper. Its motions towards the expiration of an hour's time became irregularly backwards and forwards with strong convulsive action, and in the course of the day it was found to be completely dead. No precautions were taken to prevent the access of air between the rim of the glass and the paper of the book on which it stood. It is plain from the foregoing, the reason why powerful perfumes are so offensive to even the larger insects, for here a single drop of essential oil was effectual in a comparatively short time in destroying a pretty large one in healthy condition.

In no chemical or other work that has come under my observation have I seen any notice of odoriferous effluvia having the power to destroy life as here described: in the event of any of your numerous circle of readers having met with intimation of the fact, I shall feel obliged by their communicating a short statement of the particulars.

I remain, Sir,
Your very obedient servant,
H. D.

Stepney, June 8, 1830.

M. DE LA HIRE'S DOUBLE-ACTING FORCING-PUMP.



Sir,—There is a modification of the forcing-pump described at page 408 of your 7th volume, which is the invention of M. de la Hire, and which produces the effect of two pumps with the friction of one only, for it is a lift and force pump that raises an equal quantity of water by its up and down stroke. We have but few instances of its adoption; and considering its advantages, it is surprising that it is not more frequently put into practice. In the accompanying section AA is the working barrel, in which the solid piston B moves up and down; *c* C is the feed pipe, and *d* the stop valve upon it; D is a lateral pipe proceeding upwards from the bottom of the

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working barrel until it terminates in the under part of the air-vessel E, such termination being closed by a valve opening upwards into the air-vessel, from which *f* is the discharging pipe.

So far this pump is similar to the common force-pump described as above, both in construction and action: but in the present pump, instead of the working barrel AA being open at the top, it is closed by a cap, and the piston *g g* works in an air-tight manner through the stuffing-box *h*; consequently, when the piston is depressed to expel the water out of the lower part of the working barrel into the air-vessel E through the pipe D, a vacuum will be formed in the upper part of the working barrel, and this is supplied by water through a second feeding-pipe, communicating with the former, as *e* C, and having a stop valve in the chamber *e*: the upper part of this branch of the feed-pipe opens into the top of the working barrel, and thus by the piston's descent is that part of the barrel which is above it, completely filled with water, while the lower part of it is emptying; and when the piston ascends again, all the water that has been so deposited above, is forced up the pipe *i* into the same air-vessel. The pipe *i* is also closed at its upper end by a valve opening upwards, to prevent the return of the water when the piston descends; and thus by the alternate action of *one piston* moving in *one barrel*, is all the beneficial effect of *two pumps* produced. *(Principally from Millington's Epitome of Philosophy.)*

Extraordinary advantages have always been expected from the introduction of *rotary* pumps; *theory* gives them a trifling superiority, but I very much doubt if in *practice* they will ever equal, much less surpass, the double acting pump of M. de la Hire.

I am, Sir,
Yours respectfully,
W. Baddeley, Jun.

PRESSURE AND IMPACT.

Sir,—Being but a dabbler in mechanics, I was completely puzzled in attempting to calculate how much power in the nature of impact or percussion is requisite or sufficient to move a body on a level plane subject to friction, having the weight given which exactly balances the friction. Suppose, for instance, that a weight of 100lbs. will just overcome the friction, what must be the momentum of a body weighing 10lbs., to be just able to move the load, the relative elasticity, &c. being given? Again, supposing that 10lbs. ×20 feet per second gives a certain absolute force, may I not infer that such absolute force is proportional to the velocity, other circumstances remaining the same? Granting this, let us see the result. Let the body descend perpendicularly to the horizon, upon a beam of wood supported at both ends, which will just break with a weight of 100lbs. acting at a given point; also, let our weight of 10lbs., with a velocity of 20 feet per second, exert a force just sufficient to break the beam (*i. e.*) of 100lbs.: then 10lbs. ×10 feet = a force of 50lbs.; and 10lbs. × 0 feet = a force of *nothing*. But this last is the case of pressure! Am I then to infer that pressure and impact are absolutely incomparable? That their effects are really not so, I think no one will deny; but being a mechanic, and having little time to spare for these matters, I must beg of your correspondents to enlighten

Your most obedient servant,
Peter Pressure.

June 1, 1830.

P.S.—I am not speaking (as in the pile-driving question) as to how many beams or springs a falling body will lend to a certain extent, nor how far a pile is driven into the ground, but how much velocity a given body must possess to just equal the effects of a given weight or pressure in overcoming friction, adhesion, &c.

THE EXERCISE FOR PERPETUAL-MOTION SEEKERS.

Sir,—As none of your correspondents has condescended to notice the exercise for perpetual-motion seekers, at page 121 of your present volume, if you think the following observations

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appropriate to the subject, you will be so good as to insert them; they come from one who is not ashamed of belonging (to use your own term) to the family of the *Philobrunes*, or *Perpetual-motion believers*.

Had Mr. Sims gained the power exerted by the descending weight on his bellows, he would have been fortunate indeed; but it unfortunately happens that its returning power (or an equivalent) was expended in raising it.

With respect to his question, whether a circulation of water would be kept up by the arrangement, I answer, *No;* as the velocities will be in the inverse ratios to the forces, and the descending column of 120 inches must expend itself 40 times to raise the ascending one to the height of 12 inches, as proposed:—

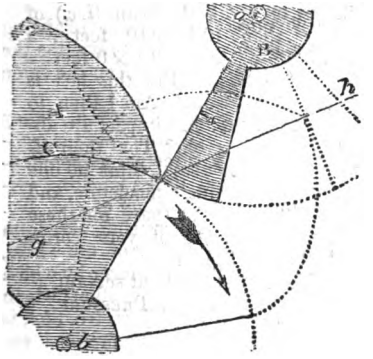
10 ft. or 120 in. × by 40 = 4800, lifting force or power.
400 in. × 12 = 4800, opposing force, resistance, or weight.

Here is an equilibrium, and nothing gained to overcome friction or the weight of the atmosphere on the piston of the pump. Were it possible to annihilate both friction and atmospheric weight, even then, unless the power exceeded the weight, the power would not be a moving one. So that upon the whole the arrangement proposed must be pronounced to be *no go*.

I am, yours, &c.

HEZRON.

INVOLUTE AND EPICYCLOIDAL TEETH.



Sir,—I have every reason to believe Dr. Robison was the first proposer of involute teeth, and I have the authority of Dr. Young (Letter to R. Buchanan) for stating this form is *not* immediately deducible from the principle of De la Hire: unless Mr. Harrison can point out the work in which the latter proposes this figure, I must conclude Dr. Robison to be the "author" of involute teeth.

Mr. Harrison tells us, "it is easy to show" that involute teeth have "*a greater slide*" than epicycloidal teeth; yet, *easy* as it is, he does not favour your readers by doing so. Now the fact is, so far from it being "*easy*," it is *impossible* to show any such thing, and *his own model proves it to be so.* But as this is merely assertion opposed to assertion, I will put your readers in a way to obtain ocular demonstration of the fact.

Draw two circles, three inches diameter, the centres of which are 4½ inches distant from each other; and draw a line from one circle to the other, as the line *c d* is drawn, No. 353, page 168. Cut a piece of thin wood or pasteboard into the form of the working part of the tooth, but long enough to have a small hole made through it in the centre of the circle, a part of which is shown in the engraving. Put a pin through the hole, and fix it in the centre of one of the circles directed to be drawn above. Form and fix the other tooth in the same way, and you will be enabled to form a clear idea of the action of involute teeth.

If the teeth are placed so that the lines 3 and 4 coincide, and the wheel A be moved in the direction of the arrow, until it arrives in the position shown in the engraving, B will be moved the same distance by the action of the teeth. It will be at once perceived that the teeth touch each other only on the line, perpendicular to the line *c d;* and that when they are moved, the parts which touch pass to the same side of the line *c d*, and immediately separate. It is demon-

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strable that any point on the curved surface of the tooth, at the instant it passes over the line *c d*, moves in the direction of the tangent to the curve at that point. And also that the tangent to both the curves is in all positions of those curves, while on the line *c d*, a right line to the line *c d*; and, therefore, that the touching surfaces "*move over the line* c d *in the same direction*:" when they have passed that line, they *no longer touch each other*, and we are not concerned about them.* But the curved surface of the tooth on A has moved the length of that curved surface from 3 to the point where the line *c d* crosses the line *o p* (I shall call this point *x*), and the curved surface of the tooth on B has moved the distance from 4 to the same point. Now, as both these surfaces moved in the same direction, the one must have slid over the other as much as its length exceeds that of the other, and *no more*. If each curve be measured by a slip of paper being bent round it from 3 to the point *x*, and from 4 to the same point, the difference will be found to be 10½ thirty seconds of an inch; the rub during the other half of the motion, as the wheels are of equal sizes, will be the same: so that the whole rub or slide of these particular teeth, in moving from the position in which 3 and 4 coincide to that in which 1 and 2 join, is 21 thirty seconds of an inch, which it will be found has moved the wheel 53 degrees.

If your readers take the trouble to cut out a piece of wood, &c., in the form of A, in the prefixed figure, and another in the form of B, put pins through the centres of the little circles *a* and *b*, and drive the pins fast into a piece of wood 4¼ inches apart, they will be enabled to form a clear idea of the action of *epicycloidal teeth*. The action begins at the line of centres, which is the position the teeth are drawn in; and when the wheels have moved 53 degrees, the teeth have moved to the position in which they are shown by dotted lines. Measuring the curved surface of the tooth from the primitive circle, or pitch line C, the point at which it begins to act, to 2, where its action is finished; and subtracting the length from the end of the tooth B to 4, gives the rub, which is 58 thirty seconds of an inch, *or nearly three times that of involute teeth*. Thus I answer Mr. Harrison's mere *assertion*, that "it is easy to show" involute teeth have "*a greater slide*" than the others. But in justice to Mr. Harrison—who seems to consider he has acquired a prescriptive right to promulgate as many opinions on the same subject as he thinks proper, each of which is inconsistent with the rest—I must admit that in the same paper he afterwards contradicts this statement; for in his fifth paragraph, speaking of the teeth mentioned by Dr. Robison, he says, "they *may* have ¼ of an inch slide:" now this, instead of being *greater*, is only about two-sevenths the slide of epicycloidal teeth on the same sized wheels.

"But," says Mr. Harrison, "they press harder." The pressure is communicated in a direction perpendicular to a tangent to the touching surfaces, or in the direction of *c d*, No. 353, page 168. A perpendicular from this line to the centre of the wheel, gives the length of the lever by which the wheels act upon each other; which lever, in the engraving in No. 353, is 1½ inches long. In the prefixed engraving of epicycloidal teeth, the lever is at first 2½ inches long, and the pressure is certainly less when the teeth *begin* to act; but when in the position in which they are shown by dotted lines, the pressure is in the direction of the line *g h*, and the lever is only $1\frac{5}{16}$ long, and consequently the pressure is then *greater* than that on the involute teeth. The moving force is of course supposed to be constant in amount and direction. The pressure never can be increased in a greater proportion than the radius of the pitch line bears to the radius of the sole or solid part of the wheel.

As to the "two wheels in a large water-mill," I shall only observe, that

* This disposes of Mr. Harrison's *assertion*, that they do *not* pass over *c d* in the same directions; and of his wonderful discovery, that "the wheels move in *circles*, and that *c d* is a *straight line*!" That this is a "plain fact" is undeniable; but it happens to have no more to do with the subject in dispute, than the whiteness of snow, or the blackness of coal, which are also "plain facts."

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many a good principle has been hastily abandoned, because some bungling application of it has failed.

I have already shown that the error Mr. Harrison charges me with in his fourth paragraph is *no error at all.*

In the fifth, Mr. Harrison makes a calculation in his usual style—he sees a little, imagines a great deal, and jumps to a conclusion.

But the most extraordinary observation is in his last—"experience shows that if the epicycloid be adapted to the smallest wheel to be driven, a larger will not fail to go well." If by going "well," Mr. Harrison means without noise, &c., he is certainly correct. But will its motion be *equable?* Surely he does not fancy it will; and *equability of motion* is the most important condition of the problem.

If Mr. Harrison can point out a form of epicycloidal teeth having less slide than those I have drawn, I shall be obliged to him.

I said I would investigate this matter myself; I intended to do so mathematically: but recollecting Mr. Harrison had never shown any very great taste for mathematical investigations, I determined, out of respect to his feeling on the subject, to proceed in the above manner. I still intend to have full-sized models made of the teeth mentioned by Dr. Robison, and to measure the slide as I have directed, should be done with the small models, of which you have given full-sized engravings. You shall have the results as soon as possible; and my reply to Mr. Harrison must not be considered concluded until they are published.

If any of your readers think I am occupying more room on the subject than it is worth, I must observe to them that it is a matter of very great importance to the makers of *clocks*, astronomical instruments, &c. &c., and ought to be very well understood by them. It was for their benefit I made my first observations; and having given an opinion, which is doubted, I feel myself bound to examine its correctness, that I may not lead them into error.

I am, Sir,
Yours, &c.
S. Y., an Engineer.

May 25, 1830.

PERSIAN TRIBUTE TO STEAM.

The following is a translation of a short poem lately written in Persian at Bombay, on occasion of the Governor-General, Sir John Malcolm, embarking in the steamer Enterprize for Surat.

The jarring elements unite to urge
The buoyant vessel through the boiling surge;
'Gainst adverse winds she holds her steady course,
Nor calms retard, nor tides her course delay;
The skill of feeble man triumphant braves
The powers of air, and lords it o'er the waves.
But whence that skill? Let thankful praise be given
Where it alone is due—to highest Heaven,
Which gave the sense which taught us to aspire
To rule the deep by water and by fire;
And nature's laws contracting to a span,
Placed powers gigantic in the hands of man.

IMPROVEMENT IN M'DUFF'S BUHL-CUTTING APPARATUS.

Sir,—The following is a sketch of the improvement in the application of my buhl-cutting apparatus, promised by me in your 351st Number.

Fig 1, is a front-view, representing all that is necessary, merely by placing the pulley A in a line with the wheel D, and under the frame instead of over, as in the original. It will be readily perceived that the whole object in view is thus obtained with very little expense, and much less trouble.

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Fig. 1.

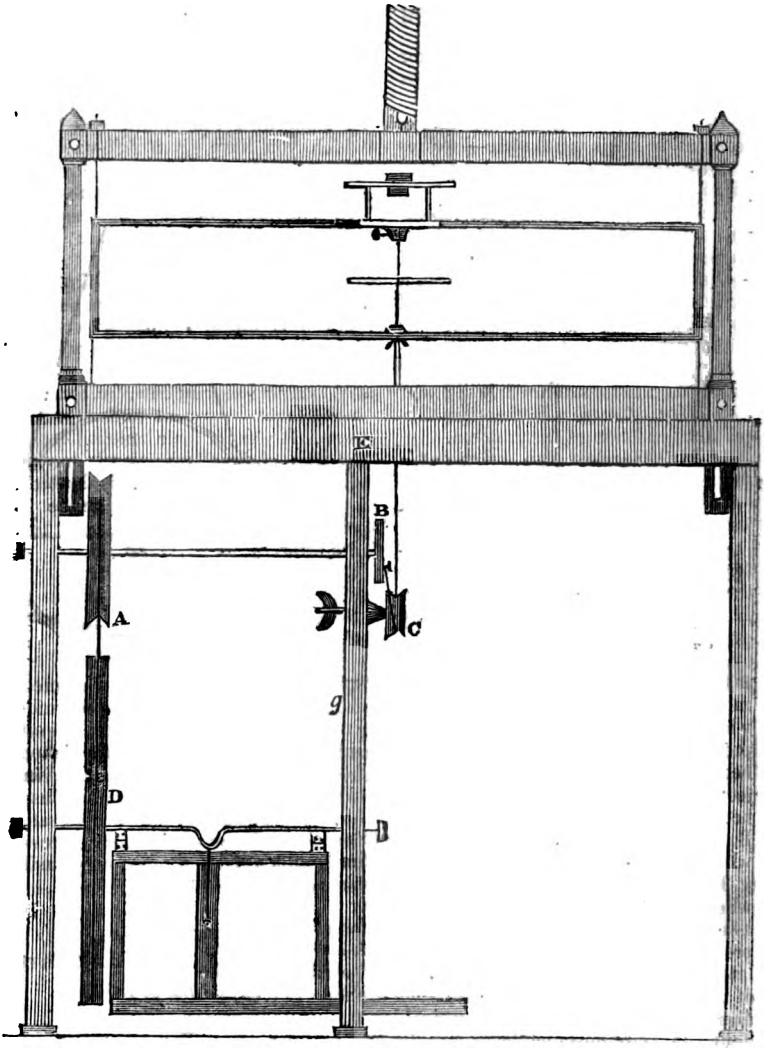

Fig. 2, is a section of the apparatus in a different position, so that a turner may be saved the trouble of taking it off and fixing it on the lathe. A bench or frame is placed behind, and the lathe-band put over a pulley *a*, as represented. It will be also observed, that by placing the pulley near the floor, it keeps the band out of the way. The only difference is, that the wheel and band are on the right instead of left; by this method a turner will save a little time.

I am, Sir,

Your humble servant,

J. M'DUFF.

6, Edmund Place, Aldersgate Street, May 5, 1830.

Sir,—I beg to offer a few words in answer to B. C. in the 366th Number of your Magazine. Perhaps owing to

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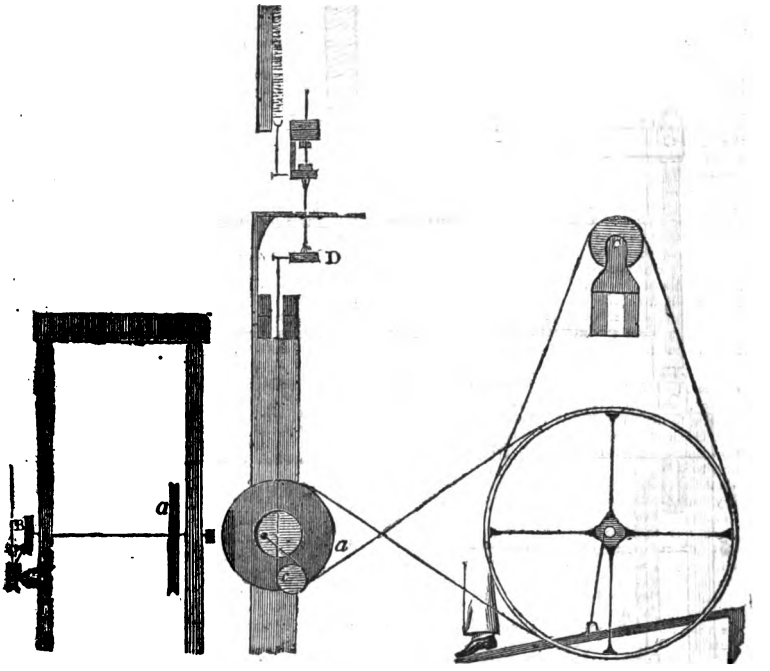
Fig. 2.



my daily occupation, a circuitous mode is the most direct to me; and when considered well, it may in the present instance also become simple, because it is easily obtained. I rejected the connecting-rod as proposed because I introduced a better, and B. C., I hope, will agree with me when he puts it in practice.

The cylinder (more like a workman when his hat's off) may be taken away, but the *spiral*, I maintain, is preferable for many reasons. It regulates, like muscular power, the action of the saw; it preserves the saw from *breaking*, when interrupted by accident (a circumstance particularly worthy of notice) and it can, if you please, like the *imagination*, or a musical-instrument, be regulated to any degree of power that may be required, which is highly necessary for so delicate a work. The wheel *q* is very *obviously* the crank he proposes, only different in form and material. The pulley T will appear also necessary, when it is considered that an inch space is not sufficient for a connecting-rod, and by means of the guide-pulley an eighth of an inch is quite sufficient for a cord or band. I hope from what I have stated, B. C. will arrive at *q*, T, by experience, as I have done, and that he will feel satisfied with the result, or an improvement which I know may very easily be made.

I am, Sir,
Yours truly,
J. M'Duff.

Edmund Place, June 9, 1830.

MINOR CORRESPONDENCE.

Air-Pump Improvements.—In accordance with the desire of S. K. that your correspondents should point out any error in his plans for the improvement of the air-pump, I beg to submit for his consideration, whether he has sufficiently provided for the *complete* expulsion of the air in the barrels at every stroke; and especially in respect to his after-thought for simplifying the apparatus, by dispensing with the valves or plugs above the piston. He will perceive that the air in the small tube *i* will return upon him at every downward movement of the piston. B. C.

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Cui Bono? presents his compliments to General Ousseley's *Amicus*, and takes leave to remark that, notwithstanding the explanations at page 251, No. 357, the General's method remains unsatisfactory. When the General divides the cylinder longitudinally, does he effect it by means of a saw of some thickness, or of one indefinitely thin? In the first case, the fragments will not be semi-cylinders, and, of course, when rejoined, their ends *cannot* be circles; in the second case, the saw could no more do its assigned work than a cobweb. Suppose, however, the cylinder to be actually divided correctly, and then rejoined; then the surface of the cylinder, and the plane on which it is to roll, must either be *perfectly* smooth or not: in the latter case, the figures are not perfectly geometrical figures, but mere approximations; in the former, it would be impossible to perform the operation because of the *slipperiness* of the surfaces: the cylinder *could* not be rolled round upon the plane. The method is therefore either an imperfect *mechanical* method, or a mere speculation, which it is impossible to put in practice.—*June* 18.

The Gilman Controversy.—Sir, it must be very evident to Mr. "S. Y." the ci-devant *young* engineer, and to every one who has read my letters, that they were all intended to controvert Mr. Gilman's narrative, to disprove his assertion that his generator had been put in operation, and to prove its total incapability of effecting what that gentleman asserts to have been done. My statements respecting the pressure required to retain steam of 300lbs. upon the square inch were not to illustrate general principles, but had all reference to Mr. Gilman's apparatus with joints, as set forth in his drawings, and not to those made with copper-wires, as subsequently called in by Mr. G. to his assistance. Mr. "S. Y.'s" *long and short bottle* witticism may be very fine to those who have imaginations sufficiently vivid to perceive its analogy to the point in question; but I confess I am so dull in comprehending such high flights of genius, that it is lost upon me. The test to which Mr. "S. Y." puts me, viz. to prove a *negative* respecting the joints, if not absolutely a bull, is a member of the Bull family. I submit to you, Mr. Editor, whether the fairer test would not be for Mr. "S. Y." to prove the *affirmative* of the proposition, by making use of the apparatus of Mr. Gilman, who no doubt would add his valuable assistance, to show that he can make it retain steam with less pressure than I have stated, and then, however pertinacious I may be, I shall be discomfited at once.—I am, Sir, your obedient servant, A PRACTICAL ENGINEER.

P. S.—I beg to be allowed to observe, that of all my assertions contradictory of Mr. Gilman's narrative of his pretended plan and apparatus, not one has been disproved, either by that gentleman or by his able ally, Mr. "S. Y.;" and the controversy is now narrowed into the mere question of the pressure necessary to secure steam of great elasticity *with so imperfect an apparatus* as that described by Mr. Gilman.

Fire-Proof Houses.—Sir, I am happy to find the cause of fire-proof houses has obtained so masterly an auxiliary as your intelligent correspondent, Mr. C. Davy. I agree with him that it is not advisable to adopt the same means of prevention in the attics or in the roof. From the great attraction of lightning for iron, iron-roofs, might be the means of bringing down upon a building a visitation which would do more damage than any accident from fire taking place in the attics—a case, besides, of rare occurrence, I would suggest the application of slate for the skirtings round rooms and on the staircase, in the place of deal skirting boards; and I think there are many other purposes to which it might be applied, so as to add greatly to the security of buildings. Since visiting Paris, in 1815, I have been much pleased with finding others of my opinion, that the French system is better than ours. No insurance offices—oak timber, not deal—and staircases of stone, not wood. Were iron and slate more generally employed, and the various remedial means mentioned all united on the principle proposed by Mr. C. Davy, many valuable lives and much property would be saved.—I am, Sir, yours, &c. ISAAC DUDLEY.

MISCELLANEOUS.

Nitrogen.—Dr. Beck, in a paper in the last Number of the American Journal of Science, maintains that nitrogen, as well as oxygen, is absorbed by the blood, that during its passage through that fluid it combines with carbon and forms cyanogen, and that the last united with iron, exists in the blood in the form of a cyanide of iron.

Enormous Hailstones.—It is related that during the wars of Louis XII. in Italy, in 1510, there was for some time a horrible darkness, thicker than that of night; after which, the clouds broke into thunder and lightning, and there fell hailstones of *one hundred pounds weight* (Encyc. Perth, II. page 14). This almost surpasses belief; but we have unquestionably authentic statements of hailstones exceeding one foot in circumference (Halley Phil. Tran.); and hailstones of the size of pigeons' eggs are of frequent occurrence.

Republics favourable to Architecture.—Greece was republican in its government, and divided into equal states. Palmyra was a republic, and there the Roman style is found in its greatest perfection. Florence was a republic when she became distinguished in architecture. Genoa built her marble palaces while a republic; and Venice was a republic while her fairest edifices arose.—*Professor Silliman's Journal.*

INTERIM NOTICES.

We have communicated "A Half-pay Officer's" letter to the gentleman whom it most concerns, and doubt not it will have a good effect.

"Hezron's" remarks on Mr. Dick's Railway—most probably in our next.

"Amor Veritatis, an old member," does not, in our judgment, materially alter the case.

"A Pedestrian" is very profuse of his thanks for our past services, but asks rather too much of us when he requests that we will "make a tour of the London shops, and report on the merits of all the new things we may meet with, so that country folks may not be taken in by merely puffing advertisements." When we first recommended Jackson's Patent Studs for boots and shoes, we did so because we saw there was a sufficient reason in their mechanical construction for the superiority claimed for them; we have since then had them in constant use, and can attest, from personal experience, the great comfort and economy of wearing boots thus protected.

Communications received from B. S.—Mr. Utting—A Young Geometrician—Mr. William James—Curiosus—Mr. Lockwood—R. C.—Mr. P. Walker—J. W. D.—Mr. Jopling—Mr. Shalders—Mr. Saul.

Erratum.—In the fifth New Mathematical Question in our last Number, for "the locus of which will be in a straight line," read "the locus of which will be a straight line."

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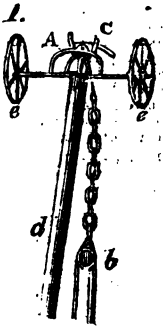
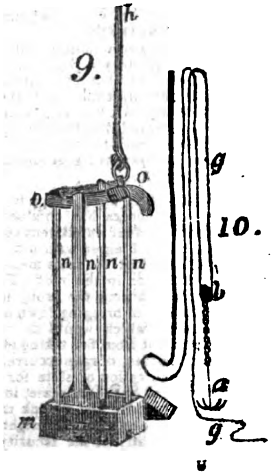
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 360.] SATURDAY, JULY 3, 1830. [Price 8d.

MERRYWEATHER'S FIRE-ESCAPES.





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MERRYWEATHER'S FIRE-ESCAPES.

Sir,—I have now the pleasure of laying before your readers a description of Mr. Merryweather's fire-escape, as promised at p. 133. This apparatus combines the necessary qualities of simplicity, portability, and facility of application, in a higher degree than any I have yet seen in operation. It occupies from one to two minutes to effect the landing of the grapnel in a second or third-floor window; after which the cradle will make, upon an average, about three journeys per minute.

The chief merit of this escape, in my opinion, is, that the persons in the street can raise and affix the grapnel —ascend in the cradle to the window —arouse the inmates of the house— and assist the timid or infirm.

Should the inmates of the house, from any circumstance, be unable to rise to open the window, it matters not; the person below breaks one of the panes of glass and effects the lodgment of the grapnel, after which he ascends with the axe and cuts away the window-frames, &c., to afford himself ingress, and egress for those within. This latter circumstance becomes necessary, because after the grapnel has taken hold, the chain lies across the bottom-frame of the window, and prevents it from being opened.

I have not seen any fire-escape, *of a portable description*, so entirely independent of assistance from those above, as that of Mr. Merryweather.

In the accompanying drawings, fig. 1, A represents an universal grapnel, with metal chain and pulley *b* resting upon the fork C at the top of the first rod *d*, to which a series of rods are jointed till long enough to reach the window, into which the grapnel is jerked, and effects a fast purchase to the window-sill with two of the prongs. The two brass wheels *ee* facilitate and steady the rods in traversing up the wall. Fig. 2, is a flexible fire-proof rectangular bag *ii*, the top of which is formed by a square iron rim, in order to keep it distended; another rim of iron *jj* is jointed to the first at *k* with stop-joints, which prevents its opening farther than as seen in the drawing. This iron rim resembling the back of a chair, makes it very safe and convenient to get into the bag, as also to put in children or infirm persons. Fig. 5, is a pole-axe and preventor, for cutting away bars, window-frames, &c.

Fig. 6, shows the bayonet-joint, by which the several rods are joined together.

Fig. 7, exhibits the mode of using the apparatus. In the first place, two men are represented in the act of connecting the rods to raise the grapnel and pulley to the window; the pulley *b* is carrying up a small line *gg* into which the strong rope *h* is spliced. In the second place, two men are represented hauling up the bag or cradle to the window, while a third is holding a rope attached to the bag, to steady and keep it from projections in the wall, or from flames if issuing from the lower windows.

Fig. 9, exhibits a still more portable apparatus, which an individual may use by himself. It consists of a small leathern trunk or portmanteau *m*, in which are buckled four straps *nnnn*, and to one of these the rope *h* is affixed, which ends in the small line, fig. 10, *gg*, with a pulley *b*, and grapnel *a*; all of which are attached to, and pack up in the trunk; the entire weight of the whole not exceeding a dozen pounds.

A person using this escape slings the grapnel into the window; when the grapnel has caught hold, he hauls up the larger rope, steps into the trunk *m*, straps the belt *oo* round his waist, and is then able to draw himself up to the window, take out any person requiring his aid, and descend in safety. If the window is too high, to render it practicable to throw in the grapnel, a small brass ball attached to a line is thrown over the house and the line drawn across the window at which any person may be situated, a communication is thus formed, and the grapnel may be drawn up and attached as before.

In the former escape, when a great length of rods is used, there is considerable difficulty in jerking the grapnel into the window; to remedy this inconvenience, Mr. Merryweather is about to adopt an arrangement, which, when the grapnel is at the

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proper elevation, will throw it off the prongs of the fork with the greatest ease.

These fire-escapes, *judiciously stationed*, and placed in the hands of *proper persons*, would doubtless effect the saving of many lives, as well as much valuable property, from destruction by fire.

I remain, Sir,
Yours respectfully,
WM. BADDELEY, Jun.

June 7, 1830.

IMPROVEMENT OF THE RIVER LUNE.

Sir,—Mr. Saul, by his communication of the plan of this river to your numerous scientific readers, has taken one of the best steps towards its improvement; and I trust that some of them will suggest practicable plans for restoring to Lancaster some part of that commercial importance which it once, and at no distant date, enjoyed. An opulent cotton merchant of Manchester, lately dead, has stated that, in his youth, he regularly attended Lancaster to make those purchases of cotton which are now made at Liverpool. The decay of the commerce of the former place is not, however, solely attributable to the state of the river, but to the superior inland navigation enjoyed by Manchester and Liverpool; which, with the abundant supplies of good water and fuel, have rendered and will maintain these towns as the port and mart of British industry in the North. It is, however, certain that vessels of considerable burden, such as those which bring West India and foreign produce, rarely frequent ports where the depth of water is not very considerable, and where the channel is not moderately straight, and which may not be entered and quitted within a few points of the most prevalent winds without the very troublesome and expensive operation of hauling; for the sharpness of their build, and the weight of their cargoes, render them, very obviously, unfit to lie on the ground without injury.

The plan of the Lune, by Messrs. Physick and Bush, differs in some respects from Yates and Greenwood's maps of Lancashire; and would have better enabled non-residents to consider the best means for the improvement of the river, had it been accompanied by a statement of the depths of the various channels, the heights of the lowest, ordinary, and highest neap-tides, and of the apogeon, ordinary, perigeon, and equinoctial spring-tides, with the depth to which the lowest neaps may be reduced and the equinoctial tides increased by winds; the direction of the most prevalent winds; the fall of the river, or the velocity of its upper and under currents; and the height of water kept up by any bars, or otherwise, at the mouth; the direction of the rocks in the vicinity; and the composition or materials of the various beds of the river.

Mr. Saul asks, whether, "supposing a steam-vessel were to work up the line he has marked on the plan A, across the sand at tide-time, it is not very apparent that much would be done for the improvement of the river." To this question my answer must be, that it is not so "very apparent" in the absence of much requisite information, that the result might not be detrimental to the navigation of the river.

The depositions in rivers are of two kinds; the one *fixed*, and the other *fluctuating*. The first is composed of the fragments of rocks, stones, and gravel, brought down from the hills at the source, by sudden and rapid currents. These, for a time, are moved about by the currents and tides until, by their gravity and attraction, they settle in hard and adhesive masses, which the ordinary flow of the river has not sufficient power to remove; and they form permanent bars, beds of shingle, &c. If these be disturbed by art, or if channels be ploughed through them in the manner proposed by Mr. Saul, the probability is, not that they would be washed away, but that they would be again deposited in the course of the stream; and there can be no certainty that they will not be so deposited in a situation equally, or more, detrimental to the navigation. No art can prevent this; nor am I aware that foresight can provide against it, except at a vastly disproportionate ex-

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pense; for these deposits are at the mercy of the constantly opposing forces of the inland and the tidal waters, struggling for mastery at the point where they meet: and wherever these powers are balanced, gravitation, attraction, and other causes, operate to prevent their farther progress to the abyss. It appears probable, that if we could form a proportionable polygon of the opposing forces of the sea, the inland water, the direction and dip of the stratification of subjacent rocks, and the most prevalent winds, one side being the direction of the river, we might find a diagonal which shall correspond with the situation of the principal obstacles of this description, or with the situation in which any new depositions shall be formed upon the disturbance of the existing banks.

The other kind of deposits are fluctuating, as sand-banks, paddocks, &c.; and their formation depends upon the gravitation of the particles of sand, mud, &c., usually suspended in the water flowing down to the ocean, or in the entering tidal-water. This process is going on daily, and is, perhaps, most rapid in the stillest waters. The operation of it is seen on flooded or irrigated lands, and in the profitable practice of warping, by which the level lands in Yorkshire are raised; where the highest spring-tides being permitted to enter through the sluices in the embanked land, the turbid sea-water deposits its contents, and then drain off at low-water. Rivers, after heavy rains, hold in suspension a vast quantity of earthy particles. Where they rise in the mountainous ridges upon which the clouds are frequently condensing, the rills, which feed such rivers, must perpetually bring down great quantities of alumina, silex, &c., in a comminuted state. The water of the Rochdale Canal, which passes over the Pennine Range at Blackstone Edge, is almost free from mineral salts, but is absolutely loaded with alumina. The Ganges yields one-fourth of sediment, at the height of its inundations. The quantity of mud brought down by the Yellow River, in China, has been found, by calculation after experiment, to yield two millions of cubic feet per hour; and, at some miles distance from the sea, the river was three quarters of a mile broad, and was running at the rate of seven or eight miles per hour. The depositions resulting from such causes, though sometimes stationary, are liable to perpetual shifting; and such changes are dependent, in a considerable degree, upon the winds, for, in some parts, banks or paddocks are thrown up frequently by freshes between the tides. These depositions are consequently very uncertain in their position; and, if such be artificially disturbed, they may and probably will be carried onwards to the ocean. From these, therefore, a river may be scoured. But it is not by a sudden rush of water, nor by an occasional flow from a level somewhat higher, that the scouring process is accomplished. The supply and the motion of the scouring-water must be constant and forcible to be effective. A deep, still pool presenting itself wedge-form to the obstruction, but gradually overflowing it, and pressing forward, by its specific gravity will the most certainly effect its removal. Or a broad mass of water flowing from a low level, but presenting itself continually to alluvial matter, though upon a higher level, will speedily disintegrate, disperse, and finally clear away the resisting body by its specific gravity and incessant motion, combined and acting upon the loose soil, which it will reduce nearly to its own level. It appears to me extremely probable, that the best means of deepening any channel through which an incessant stream flows, will be to form a pool, either deep or broad, as local circumstances permit, at the nearest practicable point to the place from whence the deepening is desired; and to allow the inland water first to accumulate, and then to discharge its overflow regularly into the main; and that the channel will thus be deepened through the intermediate sand down to low-water mark, and equal, or very nearly equal, to the depth of the pool so formed. If it were practicable to form such a pool in Overton Sands, opposite to the eastern point of the compass in the plan, p. 249, communicating on the north-east with the

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present channel, deeper than that, and shelving off in a southerly direction, I should expect that, in a few years, a channel would be opened in a similar direction to that proposed by Mr. Saul over those sands, if they be of the second description. But, if they be of the first described deposition, I should expect that the result would be a bar across, either the present channel to Lancaster, or that to Glasson, or both, and probably in the direction of a line from B to L. And I am apprehensive that a similar bar would result from the disturbance of such deposition by the means suggested by Mr. Saul, or that, instead of the present channel, there would be a second formed, of less depth, but constantly reducing the quantity of water flowing through the present passage; or that the new channel would be speedily filled up again by the alluvium brought down by the daily current, unless a body of water, deeper than the channel so opened, could be detained behind it adequate to the keeping of it constantly open by scouring.

The River Conder, from Thurnham and Ellel, in the direction of the Glasson Canal, jointly with the discharge of the water of the canal, appears to exert a very considerable scouring force upon the river below Glasson; especially from a county map of 110 years old compared with Yates', Greenwood's, and Mr. Saul's: and it will, I think, be well worth the trouble of those concerned in the improvement of the river to investigate the causes of this, and to ascertain whether the canal has not been the proximate cause; or whether it has resulted from the River Conder passing through a low, level tract, containing numerous drains, in its progress to the main stream, or from what other cause; and to find how far similar causes can be made to operate higher up the Lune. I apprehend that a great body of water is discharged from a low pool of the Glasson Canal. On reference to Johnson's canal-map, it appears, that the sill of Glasson dock is 3 f. 10. above low-water at Liverpool; that the first pool is 28 f. 1. above low-water at Liverpool: that such pool is one mile long; and that, in about 3 miles, the canal rises by lockage to 79 f. 1. the general level of the Lancaster Canal.

It may not be useless also to consider how far the old bridge piers, left standing in the bed of the river near the town, above St. George's Quay, where a water-way of 450 feet is rapidly contracted to less than 200 feet, are detrimental to the navigation, by stopping the progress of alluvium and reducing the depth above bridge; and whether it would not be advisable and practicable to remove these, and to round off the point of Skerton from opposite Water-street to opposite Princes-street.

Proceeding from Skerton seaward, the river meets the hill upon which the castle and church stand, and, diverted from its course by this, winds round it and impinges on the opposite bank, where it has washed away the alluvium and formed a second channel, divided from the present main channel by a bank Q, called Salt Area. This second channel appears to be increased by the draining streams and springs from the adjacent marsh, called in Greenwood's map Oxcliff Marsh, but not noticed in the plan; and it has probably springs arising in its bed. By the old map I have mentioned, and by Yates' map in 1786, this appears to have been the original main channel, and the present one nearer the town seems to have encroached considerably on the Lancaster side, and on the Heaton side, and to have receded from the point of Aldcliff Marsh in an equal degree; and it is evident that Salt Area has been considerably enlarged. If practicable and desirable, the draining streams and springs of Oxcliff Marsh should be carried, by a short cut parallel to the course of the river, into the main channel, and as far as the junction of the two channels, so as to assist in scouring the greater instead of increasing the less channel; and the latter should be then embanked, at its higher end, with a wall and flood-gates, opening with the flow of the tide, and closing as it recedes. The farther effect of the inland water upon this channel would be thus prevented; and the de-

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posits from the tide would have time to settle upon its bed; and the surplus of the tidal-waters would drain off and be ultimately diverted into the main channel, to its obvious benefit. When fully drained, an embankment might easily be made at the lower extremity, finally to exclude the tide, by the harbour-master directing vessels to unload their ballast on the spot, or such other means as local experience will suggest.

There are two or three forks or channels from the opposite sides, near Aldcliff and Heaton Marshes, which are not noticed in the plan, though very apparent in Greenwood's county map. These do not appear to come from the source of the river, and, probably, walls with gates, closing against the tide and opening with its reflux, would assist in draining them: after which they might be embanked against it, and warped; or the orders of the harbour-master as to ballast may be usefully directed to these points.

The main object is, I apprehend, to keep open the present main channel as far as Overton Sands, at least; and to keep open such new channel as can be formed over these. Whatever is done should be uniformly and systematically effected, and by all parties interested, lest injudicious or ill-directed efforts should counteract more matured plans. Those I have stated appear to me to be proper and adequate. I am, however, extremely sensible that I am not sufficiently acquainted with the localities to offer any opinion, and that the data upon which your readers are called upon to advise are very few; but, under such circumstances, I hope to be excused for any thing I have not done, or done badly; and, offering the little you see with hearty good wishes for the prosperity of the good old town of Lancaster, I trust it will be accepted on the ground that I have done what I could.

Yours respectfully,

GEORGE TAYLOR, Solicitor.

Pool Fold, Manchester,
June 17, 1830.

REPLY OF MR. HARRISON TO MR. BADDELEY'S PAPER ,ON MR. DRURY'S IMPROVEMENTS IN BELLS.

Sir,—I cannot but express great surprise at Mr. Baddeley's paper, in your 355th Number, page 205, occasioned by a paper of mine, in No. 353, page 163, on the subject of tolling church bells with hammers. Notwithstanding Mr. Baddeley's *intimidating motto*, I certainly should have given an earlier reply, but I have been from home.

Many have been the useful communications which this intelligent correspondent has contributed to your miscellany, but this is of a different complexion from all the rest. He has taken very great offence at my paper; at the same time I cannot see wherein I have been guilty of the least impropriety. It was quite obvious to me that Mr. Drury's method of striking bells by means of a hammer, worked by a wheel, as described by Mr. Baddeley, although an ingenious contrivance, was by no means on a good principle: nevertheless, had it not been twice urged on the public attention by Mr. Hayter, I should have let it pass unnoticed. Confident, however, that Mr. Baddeley will think differently on cool reflection, I will proceed to make some observations on his paper.

First. He wrongs me by entitling his remarks, "A vindication of Mr. Drury's improvements in *bells*;" which, so far from making the least mention of, I did not so much as hint at.* Although his motto says—

"For as you sow, you're like to reap:"

yet *he here gives us an exception to this rule.* What I *sowed* related merely to the best manner of fixing *hammers* for tolling church bells (and I still maintain it to be the best principle possible); but I have *reaped* a retort which has nothing whatever to do with hammers. Not only the title of Mr. Baddeley's paper, but his first paragraph also expressly mentions *bells*, without even alluding to the *hammers*.

Mr. Baddeley makes use of the common remark, that "two of a trade can never agree." Now I did not know that Mr. Drury casts any but small bells, which is quite a different business to mine, and is what I never meddle with. How justly, therefore, the term "illiberal" is applied to my

* We suspect the blame of thus heading the article belongs to the Editor; but how the fact stands we do not exactly recollect.—ED. M. M.

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remarks, I call upon Mr. Baddeley himself to judge.

Mr. Baddeley says I have taken advantage of Mr. Hayter's *rough* sketch: this is illiberal again. It was *the principle* of the thing, and not the fineness of the drawings that excited my attention—I perceived no preference between the two representations.

The observations in my paper respecting the force of the blow being at the caprice of the individual were undoubtedly warranted by Mr. Baddeley's representations. No minutia were shown, nor even the least arrangement, to prevent the hammer from *striking harder* when pulled with *greater force;* and I cannot suppose Mr. Baddeley means to assert the possibility of fixing a hammer on the principle represented (whatever proportion the length of the hammer-shaft may bear to the radius of the wheel) *that will always give equal blows*, although the power applied may be *very different*. He certainly should have explained how the full sound can be produced without possibility of risk or damage to the bell, by the greatest variation in the force applied.

But he observes, "these details involve *many extended* and *intricate* calculations." Indeed! why, then, not adopt *the plain simple mode* I mentioned, of lifting the hammer to a limited height, and letting it fall by its own weight? This is the best possible way of procuring equal blows, and *all these intricate calculations* will then be dispensed with. I can, moreover, inform Mr. Baddeley, that these "intricate calculations" will assuredly lead to a false result as applied to the striking of church bells. For though it is easy to adapt the weight of the hammers to the size of the bells, by a short and plain calculation, devoid of all intricacy; yet this rule, though true in itself, would be found very erroneous in practice. Some bells require heavy blows to produce their full sounds, while that of others is produced by light blows, and yet the tones of both may be equally good: of course the weight of the hammers, and the height to which they are raised, are best determined by practice.

I have never said any thing of *ringing being made easy*. It is, in general, considered to be easy; and it certainly is not only an healthful, but a very delightful exercise to numbers who practise it; but as it is several years since I ceased to take pleasure in it, I leave this matter to those who are fond of ringing bells hung and balanced in the manner of this country (which manner, by the bye, only admits of change ringing), and to those who like to hear them so rung. I need only observe, that bells so hung do not prevent the application of tolling-hammers fixed in the manner I have described in No. 353, page 163.

As to the bell at Canterbury (mentioned by Brand) requiring thirty-two men to ring it, I consider the employment of so great a number to be merely for the sake of giving eclat to the bell. It is much like the bell lately cast at Moscow (I suppose to be rung on the occasion of the late coronation of the Emperor Nicholas); it is about one-third of the weight of the large broken bell in the Kremlin, mentioned by Mr. Baddeley in No. 331; that is, it is between 60 and 70 tons weight, and twelve men are employed to strike its clapper.

Mr. Baddeley prefers Mr. Drury's scheme, because a boy of 14 years of age would be able to produce the full sound of Canterbury bell, and become an adept in the art of ringing in a quarter of an hour. Now I need only say, that any old woman or girl would immediately ring a bell by a hammer fixed as I have described, although they had never pulled one before—no practice whatever being required.

Mr. Baddeley intimates that I have a propensity to—

> "Obstruct, perplex, distract, entangle,
> And lay perpetual trains to wrangle."

How extremely illiberal is this! It was himself who first laid the train to wrangle (if it is to be so esteemed), by communicating the foolish project of striking bells by a hammer swinging from the axis of a wheel, made to revolve by a rope round the circumference, whence the most violent blows might be given, and by which mode it is absolutely impossible to preserve an equality in such moderate blows with such weight in the hammers, as bells require to produce at once their full sounds and best tones. For it is plain that a pretty smart *motion* must be given to the hammer to cause it to rise up to the bell; and if the force applied to effect this happen to be *in the least degree too small*, the hammer will fall back without striking the bell at all; and *if the force be in the least degree too great*, then the hammer is liable to strike too hard: it is, therefore, evident that there is scarcely a

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possibility of giving the hammer *the requisite medium swiftness* between its falling back before it has reached the bell, and that by which it will strike over hard. Mr. Baddeley says, I know nothing of Mr. Drury's minutiæ —certainly I do not, nor do I consider it of any consequence. I speak of the hammer as represented by himself and Mr. Hayter. If he has given a wrong representation, the fault rests with himself and not with me; and I am confident that, let the minutiæ be what they may, *as the project itself is defective in principle*, it can never arrive at an equality with the method I have described for striking church bells, even though wooden mallets should be used instead of iron hammers. I take no merit on this score; the thing has been occasionally practised, perhaps hundreds of years. I only observe that it is not likely to be equalled on any other principle, and cannot be surpassed by any means; for what can be more equal than the regular fall of a hammer from a limited height? It is positively absurd to give the title of "improvement" to any thing so manifestly inferior in principle.

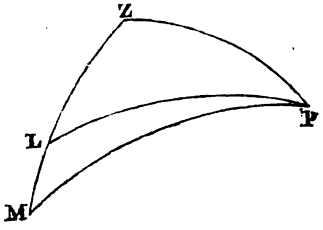
Mr. Baddeley commences his angry remarks by mentioning my "frame of mind:" and towards the conclusion, he talks of my "ill-natured remarks." Does he then arrogate to himself the exclusive privilege of communicating projects? or suppose, that because he has mentioned a *new* or an *old scheme*, every one else is prohibited from mentioning a better? I think your readers will easily discover which is the *better natured*—my paper or his remarks thereon. I have no *interest* in this matter; and my only motive for offering a word respecting it was to prevent any harm that might arise from Mr. Baddeley's recommendation of the mode of ringing bells by hammers, by showing that this was by no means the best mode of doing so: this was my sole motive, although Mr. Baddeley calls it "ill-natured."

I consider it very unhandsome in Mr. Baddeley to say that *I actually contradict myself in several instances*, without giving *a single instance thereof*. I know of no contradiction, and I feel myself justified in requesting him to point out the instances which he has, "on a careful perusal," observed in my communication. I cannot doubt the purity of his motives, but I think it a pity he should be so very sanguine in any cause as to forget himself so much.

JAMES HARRISON.

Barton-upon-Humber, June 15, 1830.

METHOD OF CLEARING THE LUNAR OBSERVATION OF THE EFFECTS OF PARALLAX AND REFRACTION IN RIGHT ASCENSION AND IN DECLINATION. BY MR. WM. SHIRES, MATHEMATICAL TUTOR.



Let the co-latitude ZP, the co-declination PL, and the co-altitude ZM, be known; or let LP be the moon's co-declination from the Almanac, and the effects of parallax and refraction amount to a quantity LM; then the remainder, LZ, is the moon's true zenith distance, and having the co-latitude ZP, find by spherics, the angle ZPL in triangle ZPL, and also the angle ZLP, whose supplement is angle PLM; ∴ in triangle PLM, we have PL, LM, and angle PLM, to find PM; and angle LPM, which angle gives the effects of parallax and refraction in right ascension; and the difference of PM and PL gives the effects in declination. If a table were thus made to each degree of latitude, altitude, and declination, it would greatly shorten the labours of calculating the lunar observations.

The above method was sent by me to the Board of Longitude some years ago. I received an answer from their secretary, Dr. Young, stating that they did not conceive it any improvement on the existing methods; but since that time there has been a problem published in the "Nautical Almanac," on a similar principle, which goes by the name of Dr. Young's problem.

W. S.

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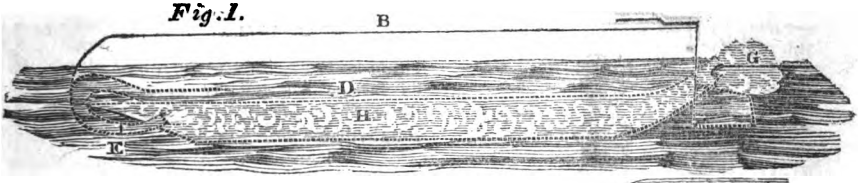
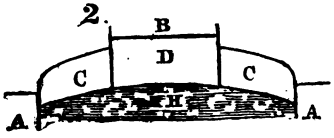
DESIGNS FOR A STEAM-RAFT, FURNACE, FLUE, AND STEAM WASTE-PIPE.

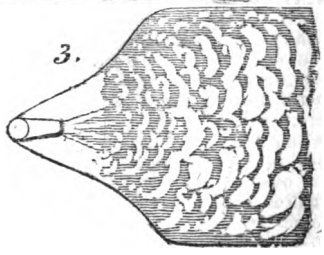
BY MR. J. WEBB.

1. *Steam-Raft.*

Fig. 1.







The sides are to be flat, upright, and parallel with each other from head to stern, and to project below the bottom as seen at A A, end section, fig. 2, which leaves an open space H from head to stern. B is the upper deck. Blowers or bellows are to be fixed in the inside D; a pipe is to be laid along the bottom, communicating with the bellows; the end of the pipe is to pass through the centre of the head into the water at E, fig. 1. The pipe must be bent, with the extremity pointing to the stern-post

When the bellows are alternately worked by the steam power employed, the pipe will become charged with dense air, which will be forced out into the water, as represented at G, fig. 1, and plan of the head, fig. 3; and by the air abutting against the water (sufficient space being left to prevent its touching the vessel), the vessel will be impelled forward. As the force of the air is expended, it will ascend by its superior lightness, accumulate under the bottom, and fill the space H. The projecting sides, as shown at A A, fig. 2, will prevent its escape; and as the air is forced out from the pipe at the head, any superabundance will escape at the stern G, fig. 1.

When the vessel rises by its acquired buoyancy, many advantages in point of speed will be obtained. The air in the space H will expand, and being rarer in the pipe by being less immersed, the bellows will work in quicker succession (the same power being applied), and the vessel on having less draught, that is, less water to displace, will meet with less resistance than if the same body were forced through the water at a greater depth.*

In shape the vessel must be made broad, but I should think it need not exceed the width of the steamers, allowing for the extent of their paddle-boxes, which exceed the breadth of their decks.

The hollow spaces, C C, which run the length of the vessel, and are intended for forming the sides, may be filled with cork shavings, in case of external injury.

A valve is placed in the pipe E, shutting next the extremity, to prevent the admission of the waters when the bellows are not at work.

The lower part of the rudder is supported by a projecting timber in the centre of the space H.

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* See "Mechanics' Magazine," No. 266, page 101.

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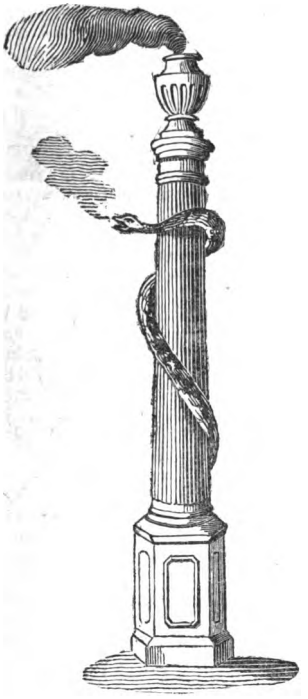
2. *Design for a Flue, Furnace, and Steam Waste-Pipe for a Steam-Packet.*



The above sketch needs no explanation.

J. W.

SUGGESTIONS FOR THE IMPROVEMENT OF THE TRACING-APPARATUS, DESCRIBED VOL. XII. P. 344.

Sir,—I beg to suggest what I consider some improvements in the instrument described in your 335th Number, for copying vases, &c.

In the first place, I think if each wire were equally pointed and bent down at the end, like the prong of a rake, it would with the after-mentioned alterations enable the artist readily to transfer (by colouring the points, or otherwise,) the design to paper.

Secondly, it would be more convenient for transferring the design, and likewise more portable, if the standard frame-work for the wires were made to *slide* tightly in grooves in the slab of wood I. The two uprights CC might be strengthened by an additional cross-piece in the centre.

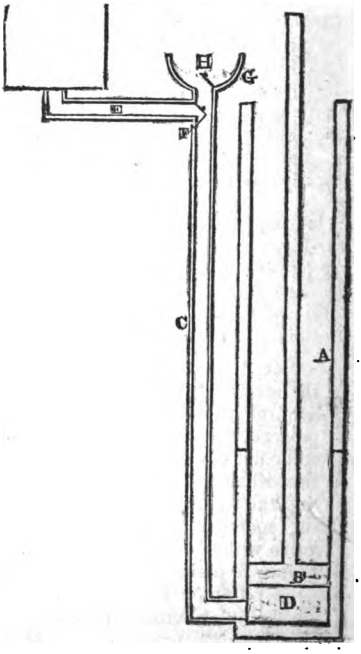
Lastly, I think it would be better that the screws EE which secure the wires should act sideways, instead of perpendicularly. I, of course, assume the division in the uprights to be from top to bottom. The wires might also be farther secured by causing the inner sides of the uprights to be roughed like a vice or file.

I am, Sir,
Yours respectfully,
THOMAS DOUSBERY.
Crown-street, Golden-square.

BAROMETRICAL EXHAUSTING APPARATUS.

Sir,—Though the principle of the barometer has been often proposed as a means of exhaustion, the following arrangement has, I believe, if not novelty, the merit at least of simplicity and power. It will carry the exhaustion as far as the air will expand; and, of course, if, as has been supposed, that expansion be infinite, the exhaustion will be so also.

Fig. 1.



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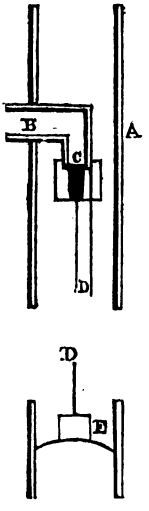
Let A be the barrel, B its piston, C a tube leading from it to the pump-plate at E; suppose the piston raised, and the barrel D filled with mercury; depress the piston, which will cause the mercury to rise in the tube C, forcing the air out of the valve H, the cup G retaining any superfluous mercury; then raise the piston, and the mercury will subside in the tube D (which must be about 40 inches long), and air will come from the receiver through the valve F: this, by depressing the piston, will be expelled, and so on. Now, the obvious limit to the exhaustion will be the tension of the valve F; and when this balances the elasticity of the residual air, the action will cease: to obviate this, the valve fig. 2 may be used.

Fig: 2.



Let A be the tube of the barrel, B the receiver tube, C a valve kept up by a spiral spring; from C let a line, D, proceed, furnished with a weight, E, sufficient to counteract the spring: this, when the mercury rises, will float, and the valve will be shut; and when the mercury falls, it will open the valve without requiring the spring of the air to assist it.

I am, Sir,
Yours respectfully,
G. S.

DICK'S SUSPENSION-RAILWAY.

Sir,—Your last Number (358) appears to me to contain two articles so intimately connected, and at the present moment of such high importance, as to be worthy of the most serious consideration of every friend to scientific knowledge and improvement. I allude to Mr. Dick's model of a railway, and the article on cog and plain wheels, extracted from the *Liverpool Mercury*. With respect to Mr. Dick's model, which, on reading your description, I immediately went to see, I perfectly agree with you, that it is well worth the notice of the admirers of mechanical ingenuity. Still, like all other ingenious speculations, it should be most minutely considered in all its bearings, as it may be expected to act in its practical operation on an extended scale. I shall not make any observations at present on that part of the model that represents the railroad, except this—that only one of the lines of road in the model appears to be on the suspension principle, for the others seem more on the principle of the tight-rope. I speak of course of the model; but when such a railway is executed in iron, and on a large scale, it may be considered as a plain rail supported by columns and piers. This, however, by the bye. What most pleased me were Mr. Dick's carriages or omnibuses (for such they literally are): I do not see any thing impracticable in omnibuses travelling on cables stretched in parallel lines, and connected in the manner of Mr. Dick's model: considering, especially, that if great weights are required to be moved, the power necessary may be obtained by multiplying the number of vehicles. Indeed, I do not regard it as at all improbable, that we may yet see omnibuses flying along the City-road in one direction on one side, and an opposite direction on the other; or a railway supported by piers and columns of a height to admit of persons passing under it. *Impossible* the thing certainly is not; it requires but the will to accomplish it, and the money necessary. No disputes could then arise from plying for passengers; every one would take his fare in rotation—step in, as his turn came, from the first floor of the coach-office, and off we should go, as well pleased as boys at Bartholomew-fair on a merry-go-round. Mistake me not, I mean not to ridicule—my heart really dances at the idea; and why? Because all this may be done with perfect safety.

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It is the principle of suspending the carriages I am so delighted with. The encouragement given by law to suspend the luggage in stage-coaches is in accordance with the same principle. Still it is extraordinary how this principle has been hitherto overlooked or neglected in mechanical operations, where personal safety is concerned: it being evident that when the point of support is below the centre of gravity of a body it is liable to a rotary motion; while, when the point of support, or more properly of suspension, is above it, vibration only can take place, except we admit the employment of a force too great and too particular in its direction to be accidentally produced. Here it is but justice to Mr. Dick to allow, that his plan not only differs from Mr. Palmer's, but is far superior to it. The weight being supported by two parallel planes, ropes, or rails, and being properly arranged, there cannot be even any vibration to a material or injurious extent, while at the same time such a small degree of vibration may be allowed as may contribute to the ease and pleasure of the passenger. Now this is not the case with the railway of Mr. Palmer, whose pannier-like loads, in case of contact with or concussion from another object, while travelling with the velocity now contemplated, would be probably overthrown. Should some jarvey of the old school have the temerity to come in contact with one of Mr. Dick's omnibuses, the vehicle would, perhaps, receive something like a slight electrical shock; but the daring adventurer would, I think, be hurled topsey-turvey to the other side of the road. All such mischief, however, may be prevented by a guard-rail or chain, supported by a projecting arm or arms from the supporters of the rail-road.

With respect to the other article alluded to in your last Number on cog and plain rails, there is too much to be said to come within the limits of this paper. I shall merely observe, at present, that I expect "R.'s" plan will be ultimately found connected with Mr. Dick's when perfected; and that as it applies to heavy carriages, or loads conveyed by locomotive-machines, it is much to be regretted that the execution of the Liverpool and Manchester Railway should not have been suspended till the subject had been more maturely considered. I have little doubt but that the plan of suspending carriages on elevated railways will become the general mode of personal travelling at least, if not for the conveyance of heavy goods—the more portable articles of commerce excepted.

If you think the insertion of these observations likely to serve the cause of science and ingenuity as connected with the public good, I hope you will give them an early insertion, and thereby oblige

Yours respectfully,
HEZRON.

P. S.—I must, in justice to Mr. Dick, add, that on reading your observations on his pamphlet, in which you anticipate a difficulty of removing a carriage from the railway in case of accident, he expressed his regret that he did not communicate to you personally the result of the consideration, he has given to this part of the subject since writing the pamphlet.

MAGNETIC INFLUENCE OF THE VIOLET RAY.

The power of the violet portion of the solar spectrum to convert a steel needle into a permanent magnet, seemed to have been well established by Professor Morchini in 1812, and confirmed by Mrs. Somerville in 1826. But other philosophers have failed to obtain results which they deemed satisfactory; some doubts appear to have prevailed with respect to the certainty of such an influence in the violet ray. Professor Zantedeschi, of Pavia, in an article communicated to the Bib. Univ. of Geneva, states, that having placed the extremity of a well-polished soft iron-wire, four inches long and one-fourth of a line in diameter, to the violet spectrum, kept in its place in a dark chamber by a heliostat, he found that in the course of five minutes the wire, when presented to a magnetic needle, manifested very decidedly the existence of poles.

The violet ray changed, or reversed, a well-marked pole in a soft iron needle.

The red, yellow, orange, and green ray produced no alteration whatever in a magnetic needle, nor in which had no sensible magnetism.

A soft iron-wire covered with a coat of oxide, and strongly mag-

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netized, exposed to the violet light, in three minutes had its south pole transformed to a north pole. A soft wire magnetized being bent, and both ends exposed to the violet ray, in ten minutes both ends became north. If the wire was oxidized, this change was effected in five minutes. These experiments were so often repeated, as to leave no doubt of the magnetizing power of the violet ray.

In the course of his investigations, Professor Zantedeschi ascertained that iron, procured from a sulphurous mine, could not be thus magnetized, nor was it easy to produce such effect upon iron highly-tempered.

At low temperatures, also, such as 6°RO+10°, the results are very equivocal; but at+20° centig. the temperature of Mrs. Somerville, or at 25° or 26° R, that of Professor Zantedeschi, the results are very striking.

If the middle of the needle be placed in the violet ray, the effects are weak or uncertain.

Perceiving that carburets* could acquire magnetism and not the sulphurets,* that needles artificially oxidized presented the phenomenon in question more promptly than those which are not so, and that the effect increases or diminishes with the temperature. Professor Zantedeschi is confirmed in the opinion, that the action of the violet ray is chemical. The light of a candle gave him in three-fourths of an hour a slight degree of magnetism, but the violet light of the moon had no effect. The latter was tried, however, at a temperature not exceeding 5° R.

Professor Zantedeschi finds his needles retaining their magnetism at the end of eight months.

Bib. Univ. Mai.

[After all, the question must be regarded as still undecided; for we subjoin from a later foreign publication, an account of a set of experiments by Messrs. Reiss and Moser, which have furnished results directly opposed to those of Professor Zantedeschi.]

Resolved to subject this question to new trials, MM. Riess and Moser procured needles of soft steel of very small magnitude, but having considerable surfaces, and they judged of the required magnetism by the relative number of oscillations before and after the experiment. The spectrum which they found was always at a minimum of deviation, which corresponds with its greatest intensity. The needles were upon a card three or four feet from the prism, the chamber was darkened as slightly as possible, and the lens had an aperture of 1·2 inches, and a focus of 2·3 inches. The violet ray concentrated by the lens was passed in the several experiments from 100 to more than 500 times along the one-half of the needle. In three instances the spectrum was kept stationary by means of an heliostat, and the needle was exposed seventeen and a half hours to the action of the ray. The experiments were also varied agreeably to the method of Baumgartner, by using steel wire three inches in length, polished in different parts, and fixed vertically before and after each experiment. At the suggestion of M. Poggeadorff they tried also the effects of polarized lights. It is sufficient to say, that the most careful attention to the results is altogether unfavourable to the opinion that the violet ray possesses any magnetic influence; and they conclude with observing, that there is good reason for rejecting an opinion which during seventeen years has from time to time troubled science.—*Annales de Chemie, Nov.* 1829.

* Of iron.

STONE ARCHES—REPLY BY MR. C. DAVY TO "A LOVER OF LARGE ARCHES."

Sir,—The observations of your correspondent, "A Lover of Large Arches," involve, at least, two very important questions; one is truth itself, and the other an examination of the mode of building adopted by the Romans. As to the first of these, I consider that had your correspondent *corrected* any unintentional errors of mine, I should have felt myself much indebted to him for such attention; but I beg leave to decline the honour of being considered the author of a sentence that never emanated from my pen. Had not your correspondent *contra-*

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dicted an assertion that I never made, I would not dwell so much upon the wording of his note, for, believe me, I have neither time nor inclination for idle controversy. He says, that "in your 356th Number it is asserted that the middle arch of New London Bridge is the largest in the world." Now I have carefully re-perused that paper, and find that the sentence stands thus: "*the largest stone arch in existence.*" It would perhaps have been better had I also said *elliptical;* but I considered that as we were treating of elliptical arches in particular, (see the paper, No. XIV.) no one for a moment could mistake my meaning. Again, he has perverted the sentence by introducing, by way of comparison, Southwark *Iron* Bridge, when I had previously mentioned *stone-arch.* The centre arch of the New London Bridge *is* the largest *elliptical* stone-arch in existence, and is at present well entitled to that distinction.

The French architects have been singularly unfortunate in the execution of their bridges with elliptical arches. In many instances a settlement at the crown has taken place, amounting to from 16 to 22 inches. The bridge over the Seine, at Neuilly, by Perronet, is a remarkable instance; the arches are elliptical, having a span of 128 feet (English), with a versed sine of 32 feet (English). The upper portion of the curve was formed with a circle of 160 feet radius, which, by its settlement during the building, and after striking the centres, was flattened till it became an arc of a circle of 259 feet radius (see Stuart's Dic.) Encomiums from French engineers themselves are not wanting to prove that our Waterloo Bridge, whose arches are of less span than those at Neuilly, is a "colossal monument worthy of Sesostris and the Cæsars." I would ask, can any one consistently compare the immense span and solidity of the centre arch of New London Bridge with the complications of materials called masonry, used in most Roman works, particularly in their bridges, how great soever the spans might be? Besides, I know of no authority which should lead us to infer that the Romans ever used the elliptical arch, although it may be said that we are indebted to them for the general introduction of the semicircular arch: their fears, with respect to its stability, or their own powers of construction, led them into gross absurdities. The segmental arch was not very common among them; but there are, I allow, remains of bridges, supposed to be of Roman origin, having arches of this contour, and of greater span than that at New London Bridge. But admitting this to be the case, is there any parallel in the circumstances? Were they not specimens of Roman emplection, incertain, and reticular?* The Roman bridges that have remained are not very numerous; in fact, great difficulty prevails, in some instances, to discover whether they were erected during the time that the Roman empire was at its height of glory, or whether the many bridges supposed to be Roman were not the works of the architects of the middle ages. Several are in style similar to that called by Mr. Gunn† "Romanesque:" a style abounding in various parts of Normandy, exhibiting a sad departure from the true Roman, which in itself is so inferior to the pure Greek. A vast number of buildings known to be of Roman origin were built of brick, and among others their bridges, which were bonded with stone, and sometimes cased with an ashlering. They seldom built with solid masonry; and in no remains can we discover their arches or walls to have been constructed with that dense and perfect mass of masonry observable in New London and Waterloo Bridges. Even Westminster and Blackfriars' Bridges (comparatively modern) are loaded with rubble. This method is now altogether exploded in works like those in question. By far more extensive (as regards length and height only), are the Roman aqueduct-bridges: but in their construction (the building) little science is exhibited; they are all supported by an immense

* Terms used for the bonding of Roman works approaching to our rubble-work and boulder-walls.

† Inquiry into the Origin and Influence of Gothic Architecture, 8vo. 1819.

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number of small arches, and massive piers, built with the usual quantum of rubbish.

I have so far given a concise answer to your correspondent on a most lengthy subject, which I trust will be found sufficiently copious in future papers on the "bridges." His next paragraph scarcely needs remark. The bridge at Chester is not finished, the arches at London Bridge *are:* if the arch of the Chester Bridge is *elliptical*, it has a considerable rise, which is not the case at London Bridge, compared to its span—if it is not elliptical, the comparison is good for nothing.

In conclusion, I would say, that if decorated architecture has retrograded to the extent that many critical writers have imagined, the constructive science, lately evinced in the architecture of stone bridges, in this country, has redeemed the architects from many cruel and unjust aspersions. Without the benefit of an establishment for either improvement or reward, and with limited means for the study of the remains of antiquity, it is to be wondered how the science has advanced at all in Great Britain. Have our architectural critics sufficiently examined the immense structures that bestride the River Thames, and the rapid improvement effected since the erection of Westminster Bridge? There is, perhaps, not one in a thousand, to use the words of Mr. Britton, "that either troubles or amuses himself by reflecting on the history, construction, science, merit, and vast cost of the artificial road which enables him to pass over the surface of the ever flowing waters. Yet to the inquisitive and reflecting mind, the subject is replete with interest—is full of 'pith and moment'—and is a fertile theme for meditation and study."

C. D.

MISCELLANEOUS.

Volcano.—Letters from Sicily give lamentable details of the late eruption of Mount Etna. Eight villages, not one of which was ever before affected by the flames or lava of the volcano, have been buried under enormous masses of stones and cinders. The coasts of Calabria, and some parts of Italy, exposed to the wind, have been covered with the same red dust as the vicinity of Etna. The country round the volcano has been completely desolated.

Vegetable Extract.—In the north of France an excellent extract of the herbs used in soups and broths is made by boiling them very slowly with a sufficient quantity of salt, and afterwards evaporating the fluid. A little of this extract, dissolved with gum arabic in hot water, is said to make capital soup.

Yellow Dye from Potatoes.—A French paper disputes with Sir John Sinclair the honour of having discovered a yellow dye in the potato flower. The discovery is stated to have been made in 1794, by M. Dambourney, a merchant at Rouen, who published a treatise respecting it at the time.

Anatomical Model.—At the sitting of the Paris Academy of Science on the 8th inst., M. Auzon, a physician, exhibited an anatomical model five feet seven inches high, in the position of the Antinoüs. It is divided into two halves for the convenience of transport, and every part is made to take to pieces, so as to represent the internal arrangement of the human subject. The muscles may be removed layer by layer, until we come to the skeleton. The brain opens, and is divided into slices exhibiting the nerves and all the ramifications. The intestines, diaphragm, lungs, and pericardium are removable; and the heart is divided into cavities, with red and dark blood. Altogether it is an astonishing production. It cost the artist twelve years of labour before he could complete it; but now he will be able to make others from it, at an expense of about 3000f. for each subject. No cabinet of anatomy, or surgical school, should be without one of these models. Even in France, where the real subject is to be had without difficulty, the members of the academy say that it will be of great service to young students.

Mount Ararat.—From a late number of the St. Petersburgh "Academical Journal," we collect some authentic particulars of Professor Parrot's recent journey to Mount Ararat. After being baffled in repeated attempts, he at length succeeded in overcoming the obstacles which beset him, and ascertained the positive elevation of its peak to be 16,200 Parisian feet; it is, therefore, more than 1500 feet loftier than Mont Blanc, which has been hitherto accounted the sovereign of mountain altitudes in Europe. He describes the summit as being a circular plane, about 160 feet in circumference, joined by a gentle descent, with a second and less elevated one towards the East; the whole of the upper region of the mountain, from the height of 12,750 feet (English), being covered with perpetual ice and snow. He afterwards ascended what is termed "The little Ararat," and reports it to be about 12,300 Parisian feet high (13,100 feet English).

Scientific Expedition.—The Russian government have determined to despatch Capt. Lütke, during the present summer, with two frigates and a corvette, on an expedition into the northern regions of the Atlantic Ocean. Iceland is to be the head-quarters of this expedition; and it is Capt. Lütke's intention to institute a series of observations on the variations of the magnetic needle and pendulum. Mr. Mertens, of the Imperial Academy of Sciences, having volunteered his services, has been unanimously appointed to superintend the botanical labours and investigations in behalf of that institution.

New Bread.—A Parisian chemist has established a bakehouse for bread made from potatos, which is animalized by the addition of the gelatine made from bones. In this way a food which is said to be equally pleasant and more nutritious than wheaten bread is obtained, at half the expense of the latter. A large quantity of biscuits, for the use of the African expedition, has been

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made upon this plan. In a time of scarcity of corn, the discovery will prove a great blessing.

Protraction of Vegetable Life.—The following extraordinary instance of the lengthened period of time during which the vital principle of vegetables may be preserved, was mentioned by Mr. Houlton, in the course of his introductory lecture as professor of botany, at the last meeting of the Medico-Botanical Society:—A bulbous root, which was found in the hand of an Egyptian mummy, in which situation it had very probably been for more than 2000 years, germinated on exposure to the atmosphere, though, when discovered, it was apparently in a state of perfect dryness. The root was subsequently put into the ground, where it grew with readiness and vigour.

Imitative Gold.—Professor Hermstadt has lately made known the composition of a fictitious gold, which is much in use among the German jewellers. To sixteen parts of pure platina add seven parts of brass and one part of zinc; place them in a crucible, cover the whole over with pulverized charcoal, and keep it over the fire until the composition is in a liquid state, and reduced to one uniform mass. This alloy has not merely the colour of gold, but possesses its ductibility and specific gravity.

Steam Carriages abroad.—It is stated, a steam carriage will shortly ply between Dresden and Leipsic. Is it possible that we shall after all permit foreigners to anticipate us in the public use of this noblest of all the results of steam machinery?

Butter.—The *Journal des Connaissances Usuelles* gives an account of the means used in the canton d'Issigny to procure excellent butter in winter. The cows are warmly clothed, so as to cause them to calve in the autumn, as it is found that the milk, after this process of nature at that time, becomes more abundant and richer in quantity; and during the severest weather in the winter, they were constantly kept clothed, and fed in the open air, as the taste of the butter is said to be much injured by confinement in the stable. The butter of this district is superior to any other on the continent.

Parallax of Fixed Stars.—In an article in the last Number of the *Edinburgh Review*, on the progress of astronomical science, speaking of the annual parallax of fixed stars, the writer says, "Dr. Brinkley has *imagined* that the DUBLIN circle indicated the existence of parallax, and he instances some stars with regard to which its influence was too great to be mistaken; but his results have not been confirmed by the excellent circles of the Greenwich observatory, so that the annual parallax of any star hitherto observed, cannot be said to be appreciable even with the largest and most delicate instruments." This conclusion is exactly the opposite of the truth. It is plain that the writer of the paper '*imagines*' that the Greenwich circle is as great or greater than the Dublin circle; now, he ought to know, because every body but himself, that has ever 'heard by report' of astronomical instruments, knows, that the Dublin circle is famous over Europe for being the largest in the world. The diameter of the Dublin circle is eight feet, that of the Greenwich six feet, therefore the size of the Dublin is to the size of the Greenwich as sixty-four to thirty-six, or nearly double. We should thank Mr. Macvey Napier to correct this mis-statement in his next Number, because it is important that the British public should not be deceived under the guise of scientific information, and that they should be made aware that the greatest astronomer at present in the world (Dr. Brinkley, new bishop of Cloyne), in using the largest instrument in the world (the Dublin circle), has come to the conclusion, that the annual parallax of a fixed star *is* appreciable.—*Dublin Literary Gazette.*

Seed Dealers.—A cottager may often make a few shillings by saving seeds, and selling or exchanging them with his neighbours or with the seedsmen. In different parts of Scotland this is done by labourers, weavers, and other mechanics. Torryburn is, or used to be, famous for its seeds of German greens; another village near Stirling for leek-seed. Dunfermline and Paisley were also noted in this way; and what are called the Russian stocks are raised from seeds saved by the weavers of Silesia and Saxony.—*Loudon's Cottage Gardening.*

Dandelion Coffee.—"Dr. Harrison, of Edinburgh, prefers dandelion coffee to that of Mecca; and many persons all over the Continent prefer a mixture of succory and coffee to coffee alone. Dig up the roots of dandelion, wash them well, but do not scrape them, dry them, cut them into the size of peas, and then roast them in an earthen pot, or coffee-roaster of any kind. The great secret of good coffee is, to have it fresh burnt and fresh ground."—*Ibid.*

Wine from unripe Grapes.—Dobereiner of Jena, who ranks among the first of German chemists, has latterly been occupied in making experiments on the possibility of ameliorating wine, derived from the juice of unripe grapes; and has discovered, that it may be rendered perfectly sweet, by injecting the powder of bones, which have been reduced to a state of whiteness by combustion.

INTERIM NOTICES.

Numerous complaints having been addressed to us, respecting the difficulty of procuring copies of our back Numbers and Volumes, we think it due to the venders to state that the fault may very probably not rest with them. Any number of the work printed since the publication came under the personal direction of the Editor 27th of June, 1829) may be had immediately on application at our office; but with respect to those of an older date, the regular supply of them has been for the present interrupted by legal difficulties, arising out of contending interests. Sooner or later, however, these difficulties will be removed—and as the Numbers have been all stereotyped from the first, no person need be in any doubt of being ultimately able to obtain whatever Numbers they are in want of to complete their sets.

S. E., of Norwich, who will find the first of his queries disposed of by the above notice, is informed, in answer to his second, that it is not intended to stereotype the "Spirit of Literature," and that persons desirous of ensuring complete sets, would do well to commence their subscription immediately. We take this opportunity of thanking the subscribers to the "Mechanics' Magazine" for the support which they have to generally extended to our new publication.

Communications received from Mr. Baddeley—J. G.—Nauticus—B. S.—Curiosus—Hippocratus—S. P.—Integer—Mr. Duval.

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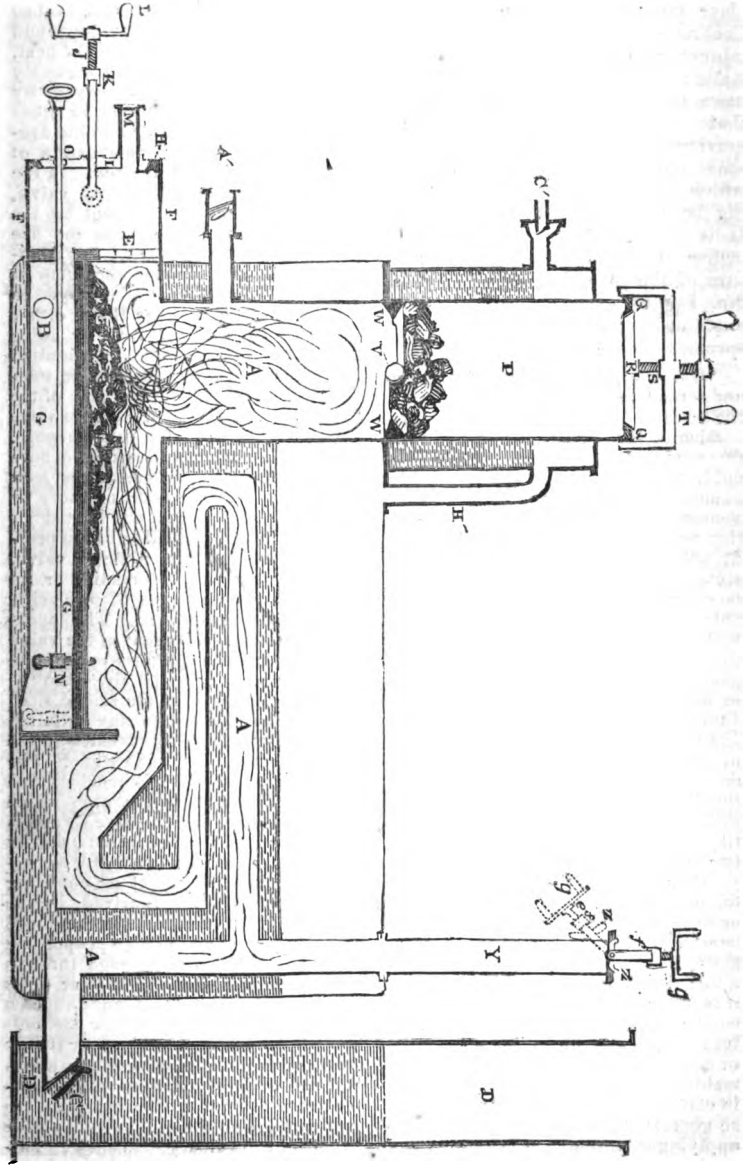
PATENT STEAM-ENGINE OF LORD COCHRANE AND MR. ALEXANDER GALLOWAY.



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PATENT STEAM-ENGINE OF LORD COCHRANE AND MR. ALEXANDER GALLOWAY.

We have related in another part of our present Number certain proceedings in Chancery, which have taken place on an application by Lord Cochrane and Mr. Galloway for an injunction to restrain Messrs. Braithwaite and Ericsson from making any more steam-boilers on the plan of that of "The Novelty." The engraving on the preceding page represents the particular sort of engine which the plaintiffs set forth as having been pirated by the defendants. It is the No. 1, spoken of in the course of the proceedings. The nature of the invention, of which this No. 1 is an exemplification, is thus explained by the patentees in their specification:—

"Our invention consists of making and forming a machine or machines for the heating of boilers, and may be denominated improved air-tight stoves, furnaces, or fire-places, into which cold, or rather, combustible and inflammable substances shall be used to generate and convey heat by the ignition and combustion of coal or other fit substances; and which air-tight stoves, furnaces, or fire-places, must be composed and formed of any suitable materials, and with means which will permit the entrance and prevent the escape of any atmospheric air or gas into or from such stove, furnace, or fire-place; but at the situation or situations formed for the introduction and exit of such air or gas by means of pumps, valves, or other suitable machinery, which shall be capable of supplying any such stoves, furnaces, or fire-places, with any required quantity of atmospheric air to keep up the ignition of any fuel or combustible substance, and, at the same time, to force out of any such stove, furnace, or fire-place, any smoke or gas so generated against any required resistance or pressure. Our invention is of a threefold character—the first part of it is for removing the inconvenience of smoke or gases generated in stoves, furnaces, or fire-places, by the ignition or combustion of coals or other inflammable substances; the second part is, in certain cases, for directing the heat so generated; and the third part is for applying such smoke or gas to various useful purposes."

The description of the figure, No. 1, we shall also give in the words of the patentees:—

"AAAA show an air-tight horizontal and vertical stove, furnace, or fire-place, with its flues to heat a boiler for generating steam, or for such other purposes to which it may be found convenient to apply the action of heat. B is the pipe through which a supply of atmospheric air is conveyed by means of a pump or pumps, or other instrument for forcing air into the fire-place to keep up the combustion of any fuel previously ignited. In the pipe B is contained a metal valve, which shuts against its seat by the pressure of the smoke from the fire and opens by the force of the atmosperic air conveyed from the pump or other proper instrument, employed to blow in the air; the pipe B may either discharge its supplies of air by being introduced under or upon the ignited fuel of the horizontal fire, or be conveyed into any convenient part of the vertical fire-place; or if more than one pump is employed for this purpose, then the air may be blown into both fires at once, as circumstances may point out. C is the plate or valve by which the smoke, gas, and heated air are compressed, according to the pressure placed on such plate or valve, either by any weight or fluid, or by any other known means of producing any required resistance. The opening or rising from its seat of the valve or plate C, allows the escape of the smoke, gas, and heated air, when the inflammable parts of the smoke shall have been subjected to any required degree of exhaustion according to the resistance made to their escape. The reservoir or vessel DD receives and encloses the end of the pipe which forms the seat of the valve C, and is made to contain the required quantity of water that shall be sufficient to perform the double object of confining the smoke until it is deprived, by the action of the fire, of any required quantity of its combustible properties; and in its exit and passage through the water, it is cleansed of some of its mucilaginous properties, and in such a purified state it may either be collected for any useful object, or it may be allowed to escape into the atmosphere without creating the inconvenience and annoyance generally experienced from the exit of foul smoke from any ordinary chimney; particularly from those chimneys em-

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ployed for the use of steam-engines. EE are the iron doors to shut off the fire; and the ash-pit GG. FF is the metal chamber which encloses the fire-doors EE, and the ash-pit GG, and which must be made perfectly air-tight when its cover II is shut into its mouth HH. This mouth or curved orifice in the chamber FF furnishes, when it is open, an introduction to the doors of the fire and the ash-pit. II, the spherical cover must be fitted and ground correctly air-tight into the mouth of the chamber FF, and which is kept in that state by the pressure of the screw J, and by which means the atmospheric air is prevented entering into the fire or the ash-pit, through the doors EE. The smoke, gas, or heated air, are equally secured from escaping through the doors of the fire and ash-pit. KK is the iron bridge which swings on its pivots, and which is connected to the chamber FF, and into which the screw J works by its lever L, and by a few turns of which screw, the cover II is admitted to move out of the way of the orifice or mouth of the chamber, and thereby gives a free entrance into it when required. MM are metal tubes, and of sufficient length to prevent the action of the fire from injuring the strong glass or glasses that are to be fixed in them for viewing the fire, and of such a diameter as will afford a general survey of the fire: these tubes, with their glasses, must be made air-tight and fixed securely in the spherical cover II, opposite the apertures made in the fire-doors to view the fire. NN is an iron rake, with a shifting handle and a roller, or feet placed at the bottom to prevent the teeth of the rake from falling entirely out of the fire bars, although it is desirable that they should be as low as possible; and it is necessary when this rake is not in use that it should be kept in the recess, made for it in the ash-pit at *d*, and which is introduced into the ash-pit for distributing the fire and for clearing the bars on which the fire is placed, and which rake moves in a ball and socket stuffing-box O, inserted in the cover II; by this means the fire is raked without opening the cover II, and without sustaining any loss of the compressed air with which the fire and ash-pit is supplied. PP is a metallic magazine, placed at the top of the vertical fire, and surrounded with a case or reservoir for holding of water to keep the reservoir from becoming too warm, and from which the boiler may be supplied with warm water as fast as the reservoir is fed with cold water; and which magazine PP may be made to contain any required supply of unignited fuel, and which magazine must be made air-tight in all its parts. Q is the frame or mouth of the magazine, through which the fuel is to be conveyed into the interior of it. R is the air-tight cover or plate, which by the pressure of the screw S working through the swinging-bridge T, forces down the cover R. Near the bottom of the magazine PP is placed a valve or door V, with an axle through or across its centre, after the manner of a throttle-valve of a steam-engine as respects the axle of the valve or door; one-half of which valve or door will rest when closed on the lower part of the seat WW, while the other half of the valve or door rests on the upper part of the seat. The form of the valve-seat, as shown at WW, will be found to be very convenient, as by its angular shape no coals or other fuel will lay upon it to obstruct the shutting of the valve or door V. The object of this valve or door is not only to shut off the unignited fuel from the vertical fire, but to allow the magazine PP to be replenished with fuel as often as required, without permitting any considerable escape of smoke, gas, or heated air; and when the cover R is closed or shut, then the valve V may be opened whenever the fire shall require any additional supply of fuel; and when it is so opened, the cover R must completely prevent the escape of any smoke, gas, or heated air, through the magazine PP. Y is a chimney, of any required height, issuing from the top of the boiler, and in connexion with the flue with its cover ZZ, its screw *e*, the bridge *f*, in which the screw works, and the lever *g*, by which it is moved. This chimney may be used for carrying off the smoke when the fire is first lighted, and when the valve or cover II is opened to admit freely and copiously the atmospheric air under the fire when the stove, furnace, or fire-place of the boiler is so used, then it is a fire on the common principle, and when used in that state it forms no part of our invention; but when the covers and valves II and ZZ, with either the cover R or the valve V, are shut by any sufficient machinery, and rendered air-tight in those parts, and a full supply of atmospheric air is forced into the fire at the place or places assigned for its entrance, then

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such a change and combination in the machinery puts this part of the principle of our invention in full force. A fire-place and its apparatus thus arranged will produce not only a saving of fuel by extracting a greater quantity of combustible material from the fuel, but will direct the heat to the object of its application more effectually than hitherto done, and will, at the same time, remove the inconvenience and annoyance sustained from the issue of large quantities of foul smoke, as at present experienced from ordinary fires and chimneys employed for the heating of boilers."

ALLEGED INFRINGEMENT OF PATENT RIGHT.

Court of Chancery, 30th June and 6th July, 1830.

LORD COCHRANE AND MR. ALEXANDER GALLOWAY *v.* MESSRS. BRAITHWAITE AND ERICSSON.

The application of the plaintiffs was for an injunction to restrain the defendants from making and selling any more steam-boilers on the plan for which they recently took out a patent (the same which was applied with so much success in the case of "The Novelty"), on the ground that that patent is an infringement of one granted to the plaintiffs as far back as the 4th of May, 1818.

The patent of the plaintiffs is, "for a machine or machines for removing the inconvenience of smoke or gases generated in stoves, furnaces, or fire-places, by the ignition or combustion of coals or other inflammable substances; and in certain cases for directing the heat, and applying such smoke or gases to various useful purposes, which will be of great public utility."

The patent of the defendants is entitled, "for a mode or method of converting liquids into vapour or steam."

The plaintiffs' bill charged, That the invention described in the defendants' patent is substantially the same with that of the plaintiffs—That in both the fire is maintained by forcing air into a furnace or close fire-place contained within the boiler and surrounded by water, so that on being forced in by an air-pump or blowing-cylinder with a piston, or by any other suitable instrument, an adequate supply of air may be obtained without the necessity of using a high chimney—That the air thus forced into, under, or upon the fire, is produced and maintained in any suitable or required state of compression beyond the ordinary density of the atmosphere, as well within the furnace as within the flues which proceed from the same through the water contained in the boiler, by obstructing the exit of the unconsumed air, the smoke, and heated gas, out of the flue, in order that the same may be retained longer within such flue, and thereby give out and apply its heat to the surrounding water with more effect and economy than hitherto produced—And that the mechanical arrangements and constructions by which the above principle is proposed to be carried into effect are also very similar, for that the fuel is introduced from the top of the boiler into the furnace by the same expedient of an ante-chamber with its external door, and also an internal door between that ante-chamber and the furnace—one of these doors being, in all cases, shut before the other is opened, by which means the fuel can be introduced without any considerable escape of the compressed air.

The defendants in their answer stated—That so far from the inventions being substantially the same, the machines made by them differ both in principle and detail, and in all respects from the machines described in the plaintiffs' specification, except in such details as are old and well known, and were in use long ago—That the specification of the plaintiffs does not sustain the title of their patent, inasmuch as a machine made on the plan there set forth would put the fire out immediately, and would not remove the inconvenience of smoke—That only three machines, as the defendants were informed, had been made according to the plaintiffs' specification, and that the same had entirely failed—That it is true the defendants in the machines made by them do maintain the fuel by forcing air into a furnace or close fire-place contained within the boiler, and surrounded by

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water, and do force in the air by means of an air-pump or blowing-cylinder with a piston, or by any other suitable instrument: but that this is not done *in order* that an adequate supply of air may be obtained without the necessity of using a high chimney, that being only a result of their mode of construction—That keeping the air which feeds the fire under pressure is an old invention; and that in the case of the plaintiffs' machine, the pressure is caused by a column of water, whereas in the machine of the defendants it is caused by a diminished size of the flue of the furnace—That compression is not resorted to by the defendants in order that the air may be retained longer within such flue, and thereby give out its heat to the surrounding water, and is not obtained by at all obstructing the exit of the air: but that, on the contrary, the great object and principle of their invention is to cause the most rapid passage of the air through the flue—That the object of the invention described in the plaintiffs' specification is to remove the inconvenience of smoke, and to act upon the surface of the water, as the paddle-box of steam-boats by means of heated air; whereas the invention described in the specification of the defendants consists in causing a rapid formation of steam by forcing an extraordinary quantity of caloric into the liquid from which the steam is to be generated in a given time: and, that there is nothing new in the hopper, which forms, besides, no part of the inventions described in either of the specifications.

The case of the plaintiffs was supported by affidavits from Messrs. Farey, Francis Bramah, Brunel, and Perkins, engineers, Dr. Birkbeck, and Mr. Edward Turrell, draftsman and engraver.

Mr. Farey swears, that to the best of his judgment and belief, the inventions are "substantially the same;" and that, therefore, the defendants have committed an infringement of the complainants' patent.

Mr. Bramah thinks there can "hardly be a difference of opinion between competent persons" on the subject.

Mr. Brunel declares decidedly, "that the defendants have committed an important and glaring infringement on the patent of the complainants."

Mr. Perkins considers, that "no practical engineer would hesitate to declare that the specifications of the two patents are one and the same in all their important parts."

Dr. Birkbeck pronounces the plan of the defendants to be "a copy of the plan of the complainants; and, consequently, if practised, an infringement of their patent."

Mr. Turrell saith, "That the patent obtained by the defendants has the title as follows:—*A new-invented Mode or Method of converting Liquids into Vapour or Steam*—and that upon comparing this title with a part of the plaintiffs' patent, it may easily be discovered, that both aim at producing an economical mode of heating boilers for the generating of steam; and that if this fact be kept steadily in view, the identity of the means employed will appear more evident—That it is deponent's opinion, from the perfect identity of principle adopted to produce the same effect, namely, that of generating steam, and also the complete identity both in the nature and use of the several parts, and also in their combinations—that the sections or divisions of the several machines herein examined and compared, are the same; and, consequently, that the patent of the said defendants is, to all intents and purposes, a direct infringement on the patent of the complainants."

The defendants produced in support of *their* case, affidavits from Messrs. Trevethick, Maudsley, Field, Fawcett, Nimmo, Vignoles, Hartley, and Forrester, engineers, Mr. William Laird, of Liverpool, boiler-maker, Mr. Thomas Weedon, paper-manufacturer, and Mr. C. W. Williams, Director of the Dublin Steam-Packet Company.

Mr. Trevethick states—That he had carefully examined and compared both patents—That the invention of the plaintiffs consists in removing the inconvenience of smoke by forcing atmospheric air against a sensible resistance of a column of water, or some

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other obstruction, by means of an air-forcing pump; by which method very great power is lost in the operation of the machine intended to be constructed on the principles thereof, and would in practice render the same useless for the purposes required—That instead of a resistance to obstruct the exit of the atmospheric air through the boiler, the defendants require a free passage for the same; and claim as their invention the passing the air through small flues at a great speed, the results of which are entirely in opposition to the result obtained by the invention of the plaintiffs; and that he does not consider there is any similarity in the two methods.

Messrs. Maudsley and Field say, that the "principle of the patent of the plaintiffs is altogether different in its object from that of the defendants, inasmuch as the plaintiffs claim by their patent to remove the inconvenience of smoke by driving the products of the fire either under water or otherwise submitting them to pressure; whereas the defendants claim to have invented a means of generating steam more rapidly than by any other method hitherto discovered, by driving or drawing the fire through smaller tubes or flues than it could be made to pass through by a natural draught or chimney." And that they are "enabled confidently to state, that there is no similarity between the two inventions."

Mr. Fawcett (of Liverpool) thinks "the principle of the plaintiffs' patent substantially different from the defendants' patent;" and "saith that he is enabled to state from experience, that the method adopted and set forth in the plaintiffs' specification would never be available, but must, on the principles thereof, prove entirely abortive: whereas, on the contrary, he has witnessed the most successful performances of the defendants' invention, and considers, from its obvious and palpable superiority, it must prove of much greater utility than any other boiler hitherto constructed."

Mr. Nimmo pronounces the two inventions to be "totally different;" and adds, that he has seen the principle of the defendants' invention "in actual operation;" and can, therefore, "from experience say, that from its great superiority to any mode of heating boilers hitherto known, it must prove of great public utility."

Mr. Vignoles says, that "the defendants' is a totally different invention, both in principle and detail, and in every respect, from the invention of the plaintiffs."

Mr. Hartley (of Liverpool) says, that he has discovered "a mechanical similarity in fig. 3 of the defendants' drawing, with fig. 1 of the plaintiffs' drawing, inasmuch as the air is described in both as forced into the furnaces thereof, but that there is nothing new in such methods described; neither do the same form any part of the invention of either the plaintiffs or the defendants"—That "the invention of the defendants consists in causing a rapid formation of steam, by forcing an extraordinary quantity of caloric into the liquid from which the steam is to be generated in a given time; and that in reference more particularly to this object," he has "directed his attention to that part of the drawing of the plaintiffs' specification, numbered 1; and that he finds that even if the method thereby described was claimed by the plaintiffs as part of the invention, but which it is not, the plaintiffs would not even in that case be able to produce the extraordinary results which are only effected, and can only be effected by the particular mode or method invented by the defendants."

Mr. Forrester (of Liverpool) states, that to "the best of his judgment and experience, the invention of the defendants is no imitation of the plaintiffs' invention, but a totally different invention, both in principle and detail."

Mr. Laird saith, "That he has been for a considerable number of years engaged in the making and construction of boilers, and that he is well acquainted with their various principles"—That "he is fully competent, from his great experience in boilers, to judge of the respective merits and principles" of the two inventions; and "that he has no hesitation in stating, that they are totally different and unlike, and for different

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objects and purposes"—That "the great advantage stated to be derived from the use of the defendants' boiler, agreeably to their specification, had occasioned a great stagnation in the business of boiler-making, which has since been removed by the defendants' invention having been proved to be of great advantage, and superior to any boiler hitherto known."

Mr. Weedon states, that he had been shown at Mr. Galloway's manufactory a boiler which he was informed was constructed agreeably to the specification of a patent obtained by the plaintiffs; that he had also seen the boiler of the defendants; but that he did "not observe any similarity between the two, excepting only that both used a bellows and fed from a hopper, which this deponent believes to be old, and not claimed by the plaintiffs as part of their invention"—That he has since examined the specifications of both parties, and "does not consider the inventions alike either in principle or detail, with the exception of the mechanical similarity in the plaintiffs' drawing, fig. 1, and the defendants' drawing, fig. 3"—And farther, that "in plaintiffs' boiler the inconvenience of smoke was not removed during the time he saw it in operation; and that the hopper through which the plaintiffs fed their fire was not applicable to the drawing in their specification, but like the one used by the defendants, and which is not claimed in the specifications of either."

Mr. Williams gives it as his decided opinion that the two inventions differ most distinctly, both in theory and practice, and adds, "that he has been very extensively connected with steam-machinery for marine purposes for a considerable length of time; that he, as a manager of one of the largest concerns of that nature, has been inquiring into every new invention for improvements in the generation of steam, and that to the best of his knowledge, nothing of the useful nature held out in the plaintiffs' specification has been effected by the plaintiffs," but "that from his experience in the matter, he considers the defendants' invention of a very beneficial nature, as by their mode, steam is generated in a very small compass, and with a greatly reduced consumption of fuel."

The case, as thus set forth in the bill, answer, and affidavits, was argued at great length by the Solicitor-General, Mr. Hill, and Mr. Pitman, for the plaintiffs; and by Mr. Horne and Mr. Rotch, for the defendants.

The *Lord Chancellor* inquired what was the object of having such a length of tube in the engine of the defendants?

Mr. Rotch explained.

Lord Chancellor.—I imagine that the object of having the tube small and of some length, is, that if you have a large tube, a great quantity of the hot air must escape without coming in contact with the pipe, and being hence communicated to the water. By having a long, narrow tube, almost all the hot air is in the progress of it communicated to the tubes. The principle is to communicate as much hot air to the tubes, and as rapidly as possible.

Solicitor-General.—There is a compression, and this they admit takes place in our machine. As I understand the thing, it is simply this:—Their machine is our machine, but their pipes are small, and ours are large.

Lord Chancellor.—Your object is to keep the hot air stationary, in order that it may communicate.

Solicitor-General.—So is theirs.

Lord Chancellor.—I rather think the object of the defendants is this:—To communicate the hot air with as rapid a succession as possible; whereas your machine has a valve at the end for the purpose of keeping it to a certain degree stationary. However, there is another point. You are arguing philosophically from the idea of what your invention is; whereas, if you look at the specification, the object is there stated to be the consumption of smoke, and two other objects which are stated ("directing the heat" and "applying the smoke or gases to various useful purposes"); and you claim no part of the mechanical contrivance, except with reference to these objects. Now, these objects, as I find them in your specifi-

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cation, are totally different from those of the defendants.

Solicitor-General.—They adopt our machine.

Lord Chancellor.—Partly. But you almost in terms give leave in your specification to any one to make use of all this machinery—either in part or combination is the phrase—provided it is not applied to the same objects as you apply it. You state distinctly what these objects are—the removing of smoke, and two others—and, as it appears to me, they are quite foreign to the particular object which the defendants have in view.

Mr. Rotch.—Your lordship will observe, that they say their furnace must be air-tight; in ours there is a free communication with the external atmosphere.

Lord Chancellor.—I do not think it is meant by that that it should be hermetically sealed. Of course, the tighter the better, because if there is any outlet, the less hot air will be forced through the tubes. The object of the plaintiffs is to drive an additional quantity of air through the fire, and hence into the tubes: the defendants do the same; but they say that the plaintiffs, to a certain extent, obstruct the very effect and object of the invention by putting the valve at the end; they take away that valve, and say the machine is better without it. Taking away the valve, makes it the less necessary that their hopper should be perfectly air-tight, but does not do away with the advantage of its being air-tight altogether. It *fits*, I suppose; so far the inventions are alike.

Solicitor-General.—As far as I can understand the case, the more air-tight, the better for the machine.

Lord Chancellor.—Are the plaintiffs the first inventors of passing an additional quantity of air through the fire for the purpose of steam-engines by means of a bellows?

Mr. Rotch.—Nobody pretends that they are the first inventors of that. It is distinctly sworn in our affidavits that it is not new.* Our invention consists in the extraordinary quantity of air driven through, and not in the mere use of the bellows.

Lord Chancellor.—I understand—but that is their case as well as yours.

Mr. Rotch.—No, my lord; theirs is a common boiler: if you do not put a column of water at the end, and if you open the flue, theirs is then a common boiler.

Solicitor-General.—I am not asking for an injunction to prevent their using an *open* fire-place. We do not ask to prevent others using No. 1 (of their specification), but No. 3. We are really disputing about nothing.

Lord Chancellor (to Mr. Rotch).—You have two turns of the pipe, and they have three.

Mr. Rotch.—The inventions are totally different.

Lord Chancellor.—Yours is more contracted in point of dimensions, and probably your whole thing is within a smaller compass than theirs.

Solicitor-General.—They have contracted their pipes in order to prevent the necessity of applying the valve at the end.

Lord Chancellor.—But the defendants say you have not used your machine. You cannot stir a step without showing that you have done so.

Solicitor-General.—We will make an affidavit to that effect.

Mr. Rotch.—I hope your lordship will allow us to make an affidavit that Mr. Galloway's machine (that which the public have been invited to inspect at his manufactory) was made subsequent to our patent.

Lord Chancellor.—You will make such affidavits as you like.

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* The reader will find, on this point, a letter from a correspondent immediately following this Report.

COMBUSTION BY ARTIFICIAL DRAUGHT.

Sir,—Having read in your last week's Magazine the information given by Mr. W. H. James, and "An Engineer," respecting the modes of promoting combustion by an artificial draught as applicable to steam-engines, I beg to refer your readers to two patents taken out for that purpose, the one 18 and the other 28 years ago; as they are both expired,

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I shall subjoin extracts from them *pro bono publico.*

I am, Sir,

Your obedient servant,

HONESTUS.

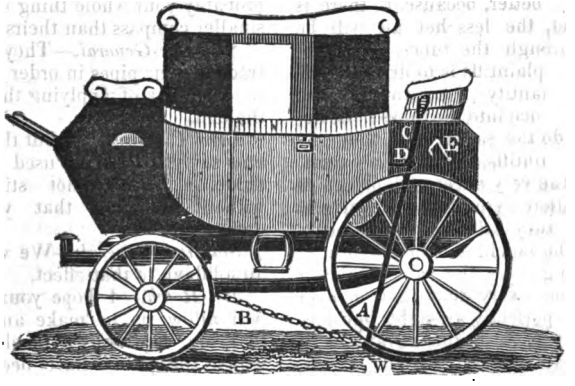
Extract from Messrs. Trevethick and Vivian's patent, dated March 24, 1802, "For methods of improving the construction of steam-engines, and the application thereof for driving carriages," &c.

"And, lastly, we do occasionally use bellows to excite the fire, and the said bellows are worked by the piston-rod or crank, and may be fixed in any situation or part of the several engines herein described as may be found most convenient."

Extract from Messrs. Fox and Lean's patent, dated Dec. 12, 1812, "For certain improvements on steam-engines, and the apparatus needful or expedient to be used with the same."

"In the construction of the fire-place to be used with steam-engines, instead of leaving the bottom or lower parts thereof open for admitting air to the fire in the usual way, we do construct the same with one or more fit and suitable openings to receive air, which we do inject or force in through a pipe or pipes, or tuyer or tuyers, by any of the well-known mechanical means for producing or affording a blast," &c.

IMPROVED COACH-DRAG.



Sir,—Having seen a model of the above very ingenious machine, I would wish it to be made public through the medium of your valuable publication. It is a coach-drag, which acts without the guard leaving the box on which he sits.

AC is a rod of iron fixed to a common shoe-drag W, chained at the end to the perch of the vehicle. AC, moves on a joint D, so that being released by the guard from the hook E, it falls by its own gravity, and the wheel runs on it and is stopped immediately from turning. When the coach stops and backs, the guard, pressing down the handle C, raises the drag and fixes it on the hook E.

I remain, Sir,

Yours, &c.

A PROMOTER OF GENIUS, AND A CONSTANT READER.

Park-lane, Towcester, February 16, 1830.

STEAM-ENGINE PROBLEMS.

Sir,—The steam-engine being generally considered as an important agent in contributing by its amazing powers to our national prosperity, wealth,

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and proud pre-eminence, any communication, however trifling, respecting it cannot be deemed uninteresting. With this impression, I beg leave to hand you the following problems, which I have been led to investigate, from having some trifling alteration to make on a small working model of one which I possess. If you think them deserving a corner of your useful and valuable Magazine, by inserting them, you will greatly oblige a constant reader and well-wisher to the work.

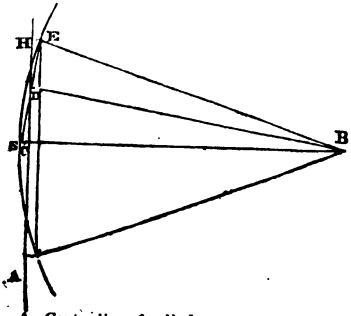
J. LOCKWOOD.

Leeds, June 21, 1830.

N.B.—About a week after I had performed the second problem, I found the same had been done, though in somewhat a different manner, in the second volume of your work, but with one important particular omitted; viz. why the difference of DE and OE (my figure) is equal to HS, which I have explained. Mr. Farey, in his valuable treatise on this subject, has also given a rule—the reason of which I cannot perceive. If, therefore, any of your numerous correspondents will show, either upon geometrical or algebraical principles, the correctness of it, I shall esteem it no small favour; as it is, if correct, much simpler for practice than the result of my investigation.

Problem 1.

Having given the horizontal distance of the centre of the fly-wheel, from the vertical centre of the cylinder, and also the length of the crank; to find the proper length of the beam.



A. Centre line of cylinder.

Construction.

Make CB = ½ the given distance of the centres, and perpendicular thereto, erect CH equal the length of the crank; bisect CH in D; draw DB, and make DS perpendicular to DB, meeting CB produced in S; then will SB be equal to half the length of the beam, and SC equal to half the vibration.

Calculation.

By similar triangles it will be,

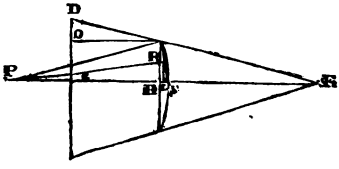
As BC : CD : : CD : CS = ·18 very near,

When CB = $5\frac{1}{16}$, and CH = $2\frac{1}{16}$.

Hence the length of the beam is = CB + SC × 2 = 12·235, as required.

Problem 2.

Having given the length of the beam = 2 DF, the length of the parallel rods DE, and the length of the crank DG; to find the length of the bridle or radial rod PS or PE.



Construction.

With DF, DG, form the right angled triangle GDF, and make GS = DE; join ES, which bisect by the perpendicular RP, meeting FG produced in P; then will PS be the radial rod required.

Calculation.

From E disect OE ⊥ GD and EH ⊥ GL: and let DF = $6\frac{1}{8}$, DE = $3\frac{1}{32}$ and GD = $2\frac{1}{16}$. Then by similar triangles, as DF : DG : : EF : EH = 1·04 inch.

And DG − EH = OD = 1·02.

Also $\sqrt{DE^2 - DO^2}$ = OE = 2·854. And, because E will be at S when D is at G, therefore DE − OE = HS = ·177. Now if RL be drawn || EH, it will be = ½ EH and LS = ½ HS. Again, by similar triangles:

As LS : LR : : LR : LP = 3·055
LS = ·088

Length of the radial rod = 3·143 in.

The dimensions I have given are those of my model.

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WATER-PROOF CLOTH.

Sir,—At a late meeting of the Paris Society for the Encouragement of National Industry, a report was read, on the means of rendering cloth water-proof by a solution of caoutchouc, the discovery of which was attributed to the French chemists, Macquer, Laffond, and others.

It is but justice to our ingenious countryman, Mr. Charles Mackintosh, to state, that in the year 1824 he patented the following process, for rendering fabrics of hemp, flax, cotton, wool, silk, and various other substances, impervious to water, by the employment of a thick elastic varnish, made by dissolving caoutchouc in a small quantity of coal oil. The proportion of coal oil required to dissolve a given quantity of caoutchouc will vary according to its peculiar quality, as well as that of the resin; but the average quantity required will be about a quarter of a pint of the oil to a pound of the resin. To facilitate the solution, the caoutchouc is to be cut into as thin shreds as possible, and the heat of a steam-bath applied. When the solution is completed, it is to be strained from the residuum.

To apply the varnish thus prepared, the cloth is to be stretched upon frames, and brushed over with it; and the varnished surfaces of two pieces of cloth, while in a sticky yet tolerably hard state, are laid one upon the other, and passed between rollers subjected to pressure, which firmly and inseparably unites them.

A flexible and thoroughly water-proof material is thus obtained, applicable to a variety of useful purposes, without the inconvenient and unpleasant varnished sticky surface, so common in other water-proof coverings.

Hancock's caoutchouc hose, which I have before described, is prepared in a similar manner.

It is worthy of remark, that, during the year 1824, five or six different patents were enrolled for various applications to useful purposes of the interesting substance, caoutchouc; and as the French chemists have so many opportunities of becoming acquainted with the discoveries of other nations, the English in particular, I am surprised that they should just now have taken the trouble to re-discover a mode of making water-proof cloth, practised and published in England six years ago.

I am, Sir,

Yours respectfully.

W. BADDELEY, Jun.

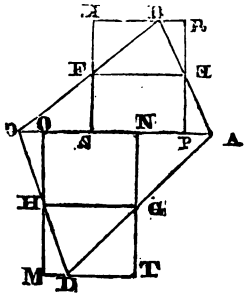
June 30, 1830.

SOLUTION OF THE SECOND MATHEMATICAL QUESTION, PROPOSED P. 7. VOL. XIII.

QUESTION.—*Disect any rectilineal figure so that the parts may be so joined as to form a square.*

By Mr. Thomas Hughes, Pupil, Mansion House School, Hammersmith.

1. Let the given rectilineal figure be a quadrilateral.



Bisect the sides AB, BC, CD, and AD, in the points E, F, H, and G. Join AC, and describe the rectangles RP and OT, as in the diagram. Then it is manifest, that the triangles ASE, ERB, are identical. So also are the triangles PFC and BKF, wherefore by transposing the triangles AES and PFC into the position of ERB and BKF, then will the triangle ABC coincide with the rectangle RP, and in the same way the triangle ADC will coincide with the rectangle OT; and because AB and BC are bisected in E and F, EF or SP is the half of AC, for the same reason ON is the half of AC. ∴ SP=ON: therefore by sliding the rectangle RP forward, so that KP may coincide with TN, then will the two rectangles RP and OT become one rectangle, and this rectangle may be so cut and the parts

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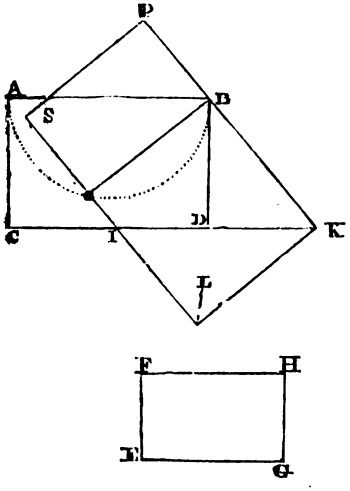
joined as to form a square. By Mr. Lucock's mechanical problem, see "Mechanics' Magazine," No. 338, p. 411.

2. When the given rectilineal figure has five sides.



The five-sided figure will be divided into a quadrilateral and a triangle by joining any two of the angles by a straight line. Then by the first case two rectangles may be constructed so that the quadrilateral will coincide with the one and the triangle with the other.

Let AD and EG be two such rectangles, and let AB be the side which is not less than AC or EH. Upon AB describe the semicircle ANB, in which apply BN=EH. Join AN, and produce A to L; draw BK parallel to AL, meeting CD produced in K, and draw KL parallel to BN. Then BNLK is evidently a rectangle, and the triangles ACI and BDK are identical, as also the triangles ANB and ILK, wherefore the rectangle AD will coincide with the rectangle BL; and since BN=EH, ∴ taking NS =EF, and completing the rectangle PN, then PN and EG will be identical; and thus the given five-sided figure may be so disected as to coincide with the rectangle PL. And, lastly, a square may be constructed, as before, and the rectangle PL resolved into spaces, which by superposition will coincide with the square, and so on for any given rectilineal figure, whatever may be the number of its sides.

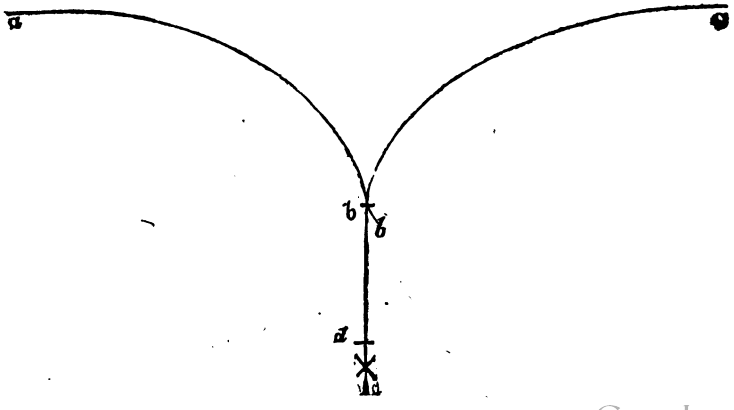
[Solutions of this question have been also received from Mr. Gilbert, A Scotch Dominie, R. R., and Discipulus. We have inserted that which seems to us to be, on the whole, the best.—EDIT.]

MR. JOPLING'S SEPTENARY SYSTEM.

(*Continued from page 94, No. 348.*)

Sir,—The relative of the cuspidated cardioid produced by rolling one circle within another of double its diameter, or by either case of harmony, is a right line, and of course the radius of curvature at the cusp is infinitely great. The union of the cusp of the cardioid with its relative right line is represented by fig. 4. Judging from

Fig. 4.



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the mode of generation, this union would appear to be fair, and if fair, then the radius of curvature at the cusp of the cardioid is also infinitely great. And may we not also infer from this, that, in all other cases, if the radius of curvature at the describing point in the generating line be half that of its relative, or that point of the other curve within and against which it rolls (whatever the radius of curvature in any other points of either curve may be), the radius of curvature at that cusp will be infinitely great.

The relative of the cuspidated cardioid produced by the exterior epicycloidal motion of one circle upon another equal to it, is also a cuspidated cardioid; and whatever the radius of curvature at the cusp may be, it is obviously in these the same as that of the cusp of the cardioid by the interior motion, since it has been demonstrated that the cardioids by either method are identical.

Having given the representation of the union of the cusps of the relative cissoids (fig. 1, page 93), it is thought unnecessary to give that of the cusps of the relative and equal cardioids, especially as these sort of diagrams occupy so much space in your pages.

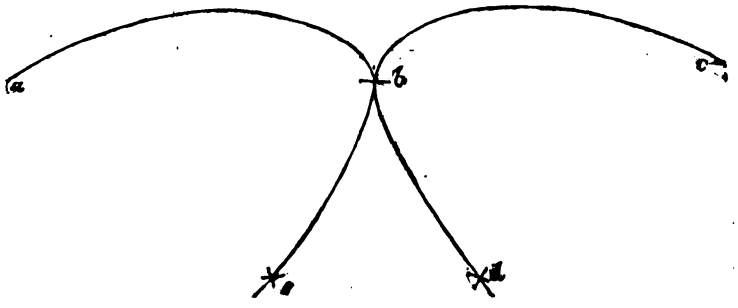
If the idea be correct that when at the describing point of the generating line the radius of curvature is half that of the point of the curve, against which, within its relative line, it rolls, to produce a cusp with infinitely large radius of curvature; then the radius of curvature of the point B in the line BCD, page 471, vol. xii. is of half the radius of curvature of its relative point *c*, in the line *b c d*, against which it rolls, in describing the cusp or commencement of the right line *c b*; and for the same reason, the cusp described by the point *c* in the curve *b c d*, while it rolls against the curve BCD, will be of the same radius of curvature as the cusp of the cardioid. This reasoning will also apply to fig. 6, page 406, vol. xii., and if correct, a point at the apex of the line A, which will describe the cuspidated conchoid, is double the radius of curvature of the point at the apex of the parabola under it, which describes a right line. Thus the radius of curvature of the cusp of the conchoid would appear to be the same as the cardioid, infinitely great.

And, as the cuspidated cardioid is also produced by equal exterior epicycloidal motion, may we not suppose that when the radius or curvature at the describing point in any other curve is *equal* to that of its relative, the radius of curvature of the cusp thus produced will, like the cardioid, be infinitely great? If so, the cusps of the cissoid produced by the rolling of equal parabolas—the cusps produced by the rolling of equal ellipses, hyperbolas, &c. &c., all have their radius of curvature *infinitely great.*

Fig. 5 is an example of the union of the relative cuspidated lines produced by rolling CE*D (fig. 12, page 234) upon AEB, and AEB within CED. The describing point in both cases is placed at the apex E of each line; the line *a b e* being described

* The letter E at the apex of the line is not in the diagram, but may be supplied.

Fig. 5.



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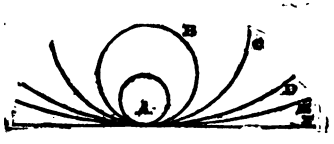
by the apex of CED, and the line *d b c* by the apex of AEB. The point where the two branches of the line AEB cross each other, will describe a similar line (an equilateral triangular figure) with similar cusps.

Now while the line AEB rolls within the line CED, the points A and B describe lines with cusps of finite radius, being arcs of circles of which CA and DB are the radii. And also if CEB roll upon AEB, then will the points C and D describe lines with cusps of the same radius of curvature.

These last are the relatives of the other two cusps of the triangular figure; and therefore if the relative cusps are of the same radius of curvature, then the radius of curvature in each cusp of the triangular figure are finite; and if these are finite, so is that of the relative cusps of the line *a b e*.

Many other cases might be given, to show when the radius of curvature at a cusp is infinitely large, and also when it is a finite quantity. But I will conclude this paper by inquiring if the radius of curvature at the cusp, produced by a point in A (fig. 6) roll-

Fig. 6.



ing within B of double its diameter, be *infinitely greater;* and by rolling A along F is *infinitely small*, what will be the radius of curvature at the cusps, if B roll along the lines C, D, and E?

I am, Sir,
Yours, &c.
JOSEPH JOPLING.

24, Somerset-street, Portman-square.

ANSWERS TO INQUIRIES.

Construction of Wind Instruments.

Sir,—The following extract from "Enfield's Scientific Recreations" is offered as a satisfactory reply to the query of Wilton X., at page 30.

The researches of the celebrated Euler accurately exemplied the following facts:—

"1. The sound produced by a flute is nothing else than that of the cylinder of air contained in it.

"2. The weight of the atmosphere which compresses it acts the part of the stretching string.

"3. The sound of this cylinder of air is exactly the same as that which would be produced by a string of the same mass and length, extended by a weight equal to that which compresses the base of the cylinder."

Yours, &c.
J. G. Jun.

Velocity of Water in Pipes.—Answer to the Inquiry of an Emigrant, vol. xiii. page 232.

Sir,—It appears evident to me that the object required cannot be obtained from the conditions given in the above inquiry; viz. that *precisely the same quantity of water* is to be delivered *at any distance* from the reservoir. For if we suppose the distance from the reservoir, at which the water is to be delivered, to be one foot, the bore of the pipe into the side of the reservoir one inch, and the aperture at the point of delivery half an inch in diameter, as per question, it is evident that the velocity of the water will be very nearly equivalent to the velocity acquired by a body in falling perpendicularly through a height of 30 feet, or nearly equal to 44 feet per second. The discharge being a *constant quantity* in each case; i. e. *at any distance* from the reservoir, it must consequently be equal to that discharged in its immediate vicinity, or *from the reservoir direct*. Now as the protrusion of the water through the pipe, let the increase in its diameter be what it may, is not instantaneous, the same quantity cannot be discharged in each case; i. e. *at any distance*, even if the radius of the pipe at its supposed extremities be equal to the head of water in the reservoir, or = 30 feet. The quantity so discharged will not be strictly equal to that discharged at the reservoir through a similar aperture, as when the water issues from the pipe at a distance of one, ten, or one hundred miles, a reduction of the pressure of the superincumbent particles will take place for want of an instantaneous supply to occupy the place of the water discharged; and which, in an open canal, would produce a fall proportional to the distance from the re-

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servoir. Consequently the discharge would be less than if the head of water were *rigorously constant*. Now as the water passes from the reservoir into the pipe, the particles of water contained in the reservoir fall together, and supply the place of those which have recently been discharged, as they, comparatively speaking, experience no friction, and a constant head of water is thus kept up; while, on the contrary, the aperture by which the water enters the pipe being only one inch in diameter, and having to pass through a distance of one, ten, or one hundred miles, must experience considerable retardation from the effects of the particles of the water rubbing against the sides of the pipe, and against each other. Let, therefore, the increase in the diameter of the pipe be what it may, I deny the possibility of obtaining the object required from the conditions as given in the inquiry; i. e. We cannot deliver, *at any distance* from the reservoir, *precisely the same quantity of water* as at any other distance (*I say precisely the same quantity, mind you*).

I am, Sir,
Yours, &c.
J. UTTING.

Lynn Regis, June 10, 1830.

P. S.—As the proposer of the above inquiry did not seem satisfied with the correctness of the *formula* employed in the solution of a former question, viz. the very nearly approximating, but complicated formula of Du Buat; and being aware of the difficulty attached to the solution, I am at a loss to divine the *object* your correspondent had in view when he proposed the present question, which is one of much greater difficulty (provided it would have admitted of a solution). There is, however, no formula, that I am aware of, that would resolve such an inquiry; or that would give precisely the actual discharges at the respective distances required by the question, for "*a pipe whose diameter varies.*" The results required could not be obtained from theory, unassisted by experiment; and a good deal of time and attention, in making experiments, &c., would be requisite to the construction of a formula, in order to obtain the object required.

Truss-Springs.

Sir,—Perhaps the following may be useful to "A Young Truss-maker." Take the truss-spring, bent into the form required, heat it and plunge it into a mixture of half a pound of sulphuric acid and 2 gallons of soft water, which will harden the spring, and cause it to retain the same shape as when put in, without cracking. The method of tempering the spring is as follows:—Hold the spring over the fire till it becomes warm, then rub a piece of tallow along it (or dip it in oil), and expose it to heat till the oil or tallow inflames; before the flame ceases, quickly slack it in oil or the water before mentioned, The cheapest method is to cut it out of the sheet-steel; but a spring drawn by the hammer is more durable, and a good ready workman will drawn one by the hammer almost as soon as it can be cut out of the sheet. The steel best adapted for the purpose is the shear-steel, employed at mills for steeling slitting rolls, generally called double shear-steel, which will stand a heat nearly equal to iron.

I am, Sir,
Yours, &c.
B. S.

Leeds, June 12, 1830.

Fire-Engines.

Sir,—In reply to the inquiry of B. C., in your 358th Number, I have never found the air in the air-vessels of fire-engines absorbed to such an extent as to become perceptible, much less inconvenient.

I am of opinion that absorption does take place in all cases when atmospheric air and water are in contact under pressure; or, even at the ordinary atmospheric pressure, when the water is in a finely divided state. But I also consider the amount of absorption to be but small, and that it must be carried on for a considerable length of time to produce a palpable effect.

In a *hydraulic ram* all the apparatus is very simple, and easily made air-tight; and its action depends upon the gravitating power of water to produce momentum, independent of atmospheric pressure. Under such circumstances, although the air is absorbed but slowly, yet, as it is going on continually, it will at length have a visible effect upon, and ultimately stop, the action of the machine.

There is, however, very little analogy between a *hydraulic ram* and a *fire-engine*; for in the latter there are many parts which it is exceedingly difficult to make air-tight; such, for instance, as the suction-pipe, espe-

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cially if made of leather, the feeding-cock, and the pistons. I believe I may venture to say, that eight fire-engines out of every ten admit four times as much air into the air-vessel as is taken out by absorption.

But even if we suppose every part of a fire-engine to be perfectly air-tight, it will hardly ever be worked long enough to render the effect of absorption visible.

In a word—the air in the air-vessels of fire-engines is not absorbed to any extent, and it is quite unnecessary to make any provision to recruit it; were that expedient necessary, it might at any time be done by allowing the engine to draw in air, either by raising the suction-pipe out of the water, or by turning the feeding-cock so as to bring about the same arrangement.

I hope this brief reply will prove satisfactory to your correspondent; the subject is one of much importance, as well as considerable interest; its study involves many curious circumstances, and offers a wide field for experimental investigation.

I remain, Sir,

Yours respectfully,

W. BADDELBY, Jun.

June 29, 1830.

MINOR CORRESPONDENCE.

Sir,—My only reason for continuing the controversy with "A Practical Engineer," is to obtain for your readers his much-vaunted mode of finding the necessary strength for the bolts. I will give him full liberty to suppose the joints made with copper-wire, or without, or in any other way he pleases, as long as they are made by *compressing together metallic surfaces which fit each other*. I invite him to publish his mode of making what he has intimated to be a *difficult* calculation; and I promise him if it proves correct, I will give him all due credit for it, and confess myself wrong when I said it was a matter of "*simple* calculation:" if his method is incorrect, I will endeavour to point out the errors, in such a manner as will improve his knowledge of the subject without wounding his feelings; but if he persists in sullenly refusing to give any reason for what he has stated, or to explain how he derived from *practice* the notions which induced him to assert that "quadruple" the strength spoken of would not be sufficient, I shall feel strongly tempted to lay on the lash, which he has already smarted under, as unsparingly as I think it will be well deserved.

Yours respectfully,

S. Y. (an Engineer.)

June 26, 1830.

P. S.—Your readers will perceive on referring to my last paper on this subject, that I have not asked Mr. "Practical" to prove a *negative*, but an *affirmative*, which, if what he says is true, must be very easy to him to prove.

Besors Company.—Sir, Can any of your readers inform me whether the *Besors* mining, colouring, and smelting company, advertised in 1827, is in existence; and whether the *patent* method described in their circulars as saving three-fourths in fuel, and producing two-thirds more block-tin from the same quantity of tin ore, has been brought into practice, and with what success? The circular of the Company is now before me, soliciting a capital of £50,000, but there is no name to it, nor any address where to apply for shares. A line addressed, post paid, with particulars, to A. B., at Mr. Glendinning's, No. 25, Hatton Garden, will oblige. Should the system prove what it is represented to be, a proposal will be made to the parties interested in the patent.—I am, Sir, &c. B.

Drury's Mode of Ringing Bells.—Sir, Finding that my sketch for a bell-room, or, rather, for the frame-work, which I considered proper for hanging tower-bells securely, as adapted to Mr. Drury's proposal, as set forth in a late Number of the "Mechanics' Magazine," has been so far misapplied as to bring my well-meant proposal into the field of controversy between two of your correspondents—I shall be glad to settle the matter as far as I am implicated, by declaring that it was my intention, both in the sketch, and in what I said on the subject, to confine myself to the designing the frame-work and the explanation of it, leaving the bells and the ringing-apparatus to those better informed on the subject. I certainly did sketch "a wheel with a tongue fixed to it, and a line to represent a rope," at the end of which rope your "engraver, as you explain, *added a ringer*," your engraver and I having, "Gilpin-like, galloped beyond the *Bell*." But why all this fuss about it? Get but a tower full of bells, fixed as safely as the frame which I sent to you would admit of, and I have no doubt—indeed, there is no room for doubt—that the bells may be so struck as to produce their full tone without cracking—any thing but the controversy which my "rough sketch" has produced. Although it is not my intention to mingle in the dispute, I sincerely thank Mr. Baddeley for his so terming my design, it being the best apology he could publicly plead for me. Nor can I join with Mr. Harrison in feeling the expressions of "rough sketch" as "illiberally" applied by Mr. Baddeley, jun.

I am, Sir, yours, &c.

CHARLES HAYTER.

16, *Cirencester-place, Fitzroy-square,*
July 3, 1830.

P. S.—If the bells are fixed, the tongues must be made to vibrate and (*I* think) strike on the side of the bell by a glancing stroke. Who will presume to argue that there is not mechanical knowledge enough extant to accomplish this? It was the goodness of the *original project* which excited me to offer just so much on the subject as to call forth knowledge and power in its behalf, and not to embarrass it.

INTERIM NOTICES.

Part I. of the "Spirit of Literature" was published on the 1st inst.

Communications received from Mr. Palmer—Miliwal Thignk—Pit—Onesiphorus—A Constant Reader—Mr. Hubert—A Lover of Large Arches.

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M. SALMON, Printer, Fleet Street.

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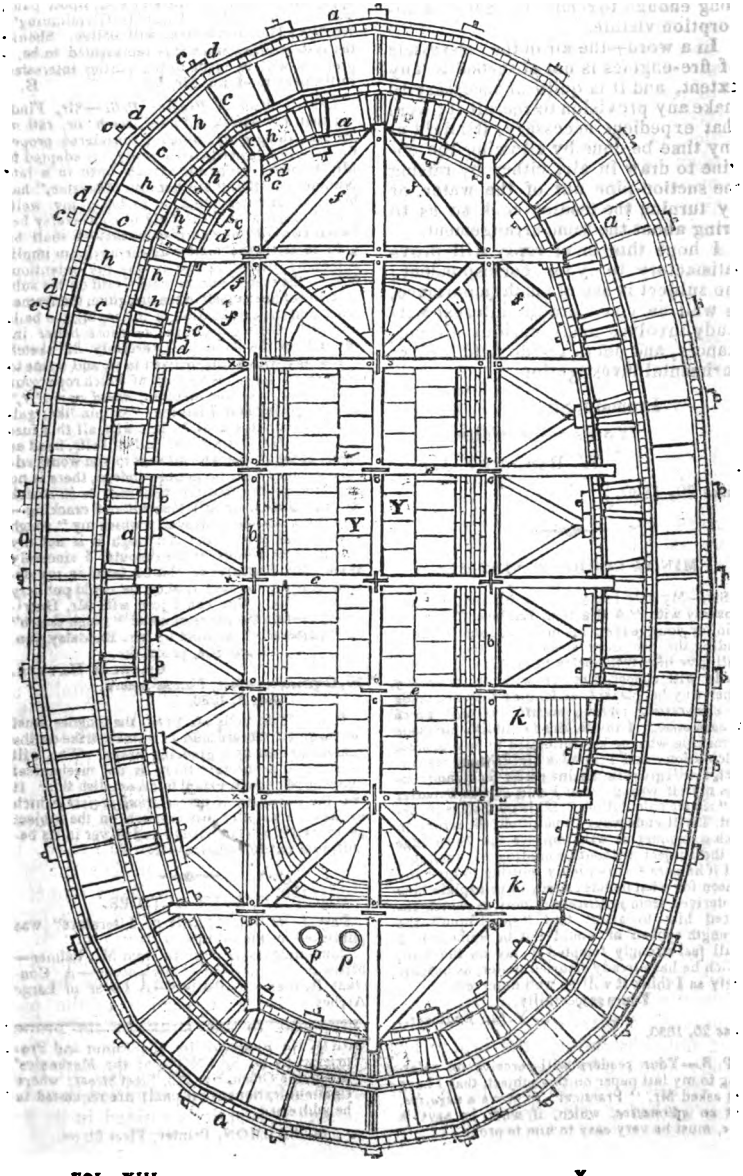
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 362.] SATURDAY, JULY 17, 1830. [Price 3d.

THE COFFER-DAM OF NEW LONDON BRIDGE.



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DESCRIPTIVE ACCOUNT OF THE PRINCIPAL BRIDGES ERECTED OVER THE RIVER THAMES. BY MR. C. DAVY, ARCHITECT.

No. XV.

Remarks on Founding, by Caissons—The Coffer-dam of New London Bridge.

The serious occurrence that has lately taken place at Westminster Bridge, together with the expenses likely to be incurred at no distant period in repairing nearly *all the bridges* erected over the Thames, is a convincing proof that the mode of laying foundations by means of caissons is fraught with the greatest danger, and should be now wholly exploded. It is pretty clear that from the first, doubts were entertained of the stability of such a mode of proceeding; but, as is too often the case with public structures erected by means of individual subscriptions, economy has been consulted at the expense of permanent advantage. Advocates for such parsimonious conduct may still be found among political economists; but if we look at the disastrous effects resulting from it, I think it will appear that a miscellaneous body of individuals should not be allowed to interfere with such national works, where cramped means and conflicting interests combine to affect the work and labours of the artist to a ruinous extent. The truth is, that in most extensive works of this description, any thing like a return for the capital invested can never be calculated upon. The most magnificent undertakings on this account are either allowed to remain unfinished, or if completed, ruin the speculators.

The following comparison between the estimate and cost of two or three of the principal bridges will exhibit this in a more striking point of view:—

	Estimates.	Cost.
Waterloo	£500,000	£1,200,000
Southwark	360,000	700,000 and upwards.

Vauxhall Bridge cost near £265,000. Six dividends have been received upon each original share of £100., advanced nearly 20 years ago, amounting altogether to £6 5s., making an annual average sum of 6*s.* 3*d.* for each £100.

		Premium.	Dividend.
Hammersmith has paid on each share of	£50	25*s.*	2 per cent.
Southwark - - - -	63	3	£1 19*s.* ditto.
Ditto new 7½ per cent - -	50	30	1 10 ditto.
Vauxhall - - - -	100		
Waterloo - - -	100	3	

I now proceed to say a few words on caissons and coffer-dams. It is uncertain whether Mr. Labelye was the inventor of the caisson, or that it was previously adopted in France; the latter was more likely the case. It is, however, certain that its first employment on a large scale was at the bridge over the Thames at Westminster. It naturally enough occasioned much talk at the time as being in the highest degree scientific, but before the bridge was opened, part of it gave way, throwing the works back nearly a year and a half. Since that period most of the piers have been rebuilt; yet, notwithstanding, the bridge has lately again given way. The cause of all this decay in this bridge, and also in that of Blackfriars, is said to have been the indifferent quality of the materials. This, in part, may be true; there are other causes that I shall mention as being by far more likely to ruin those two structures. It is my intention to give full explanatory drawings of the caisson method of founding, and therefore I shall, in this place, only generalize the description. A caisson is an immense raft of timber, constructed of a form and size suitable to the pier; it is furnished with a bottom, ends, and sides, but the ends and sides may be drawn away: a portion of the pier proposed to be sunk to its proper place is erected in this sort of flat-bottomed barge; and when all is in readiness, water is admitted in order to sink it, and it is guided in its de-

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vent by ropes, &c. The sides and ends are then withdrawn, and float to the surface, the lower planking remaining under the stones.

The caissons at Westminster Bridge contained upwards of 150 load of fir timber of 40 cubic feet each, and were of more tonnage than a 40 gun vessel.* Now it will be seen that by employing such method, the pier rests upon a timber platform. It will be readily conceived that by this means the irregularities in the bed of the river cannot be examined with the facility and accuracy which are obtained by the coffer-dam or batardeaux. One of the dangerous consequences is, that a current or spring may insinuate itself under such platform, and undermine the work to a ruinous extent. Besides, if from any natural cause a very low ebb takes place, the air will be admitted to the unprotected layer of timber, and nothing can then prevent the destruction of the building.

The general description of a coffer-dam has heretofore been given; the accompanying drawing (copied, with some alterations, from Stuart's "Dictionary of Architecture") will serve to elucidate it. The pressure of water on all sides of a coffer-dam is so great, that the internal space must be strongly truss-framed to keep it from bursting in upon the work. The three rows of piles, *d d d*, were driven round in an elliptical, form and firmly bolted together at intervals, *c c c* and strong pieces, *h h*, introduced, which are acted upon by compression against the piles by the force of the ambient water: this force is transferred to the braces *f f*, and from thence to the interval and double diagonal framing *f f b*, which receives another force from the direct current of the river. As timber when acted upon laterally is weak, the beams, *e e* and *b b* are framed and strapped together, forming at their abutting joints, *x x x* abutments for those braces acted upon by compression. *p p* are the pumps for withdrawing the water arising from springs or leakage; K K stairs for descending the coffer-dam; and Y Y is the pier of solid masonry with its footings, mode of bonding, &c. The piles forming the dam are finally withdrawn by either of the methods described in papers Nos. 12 and 13.

(To be continued.)

* Hutton's Tracts.

REVIEW OF PAPERS ON FLYING.

(Continued from p. 255.)

The "new system of aerostation" by S. R., p. 161, vol. xi. is one of those fantasies which sometimes proceed from a vivid imagination. Inspired, in all probability, by W. C—'s pen, so far from giving us any thing that can possibly be realized, he only presents us with a train of fanciful flights, in which some instances of the ludicrous are not excepted. After dilating upon the prodigious advantages of this mode of travelling, which will enable us to "explore unknown regions—penetrate to the interior of continents—pass over inaccessible forests—traverse the deserts of Arabia and Africa in the cool, salubrious breeze, instead of having to endure the heat of tropical climes—add greatly to the collections of the naturalist and man of science, and amply gratify the geographer and mineralogist by new discoveries—besides affording a more acceptable passage than the frozen oceans to the northern and southern poles," &c., S. R. observes, that "the grand question with all rational people of good, sound common sense, will now be, Is this mode of transporting person and property a safe one?" Now, with all due deference to S. R., I beg to differ with him respecting the first grand question in this case; for I conceive that with all rational people of good, sound common sense, the grand question will be, Is the thing possible? There can be no question as to the importance and utility of such a mode of travelling; but to enumerate the great benefits that are to be derived from it thus in detail, before the means themselves are attained, puts me in mind of the girl with the basket of eggs. From S. R.'s thus talking of the weight of a person being of the *least* importance, and the means ample enough to convey the heaviest man in the most effectual way—and by the stroke of the feet in forcing down the wings raising him higher in the air at

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every stroke, &c.—one would really conclude that this correspondent has also lost sight of the powerful and never-ceasing action of gravity, and more especially that the aeronaut has some tendency to descend during the time he is raising his wings. Supposing the wings actually to sustain the incumbent weight at the instant of their downward strokes (though assuredly they will fall miserably short even of this), it would, according to S. R.'s plan, require a force many times greater than the person's weight to bring them down with the requisite rapidity to produce such effect. It is obvious that the principal resistance or effect of wings must be near their ends where the motion is greatest; and as the impulse to be given by the moving power must necessarily be applied where the motion is much less, such impulse must therefore be the more forcibly applied: whereas it seems S. R. imagines the aeronaut will be able to ascend with considerable celerity without any extraordinary exertion.

As to the wings being pressed down by the legs, the efficiency of the legs for the purpose may be appreciated by the employment of carrying large sacks up a flight of steps. Such a load probably would not be so much as double the weight of the person carrying it, and yet he would perhaps be a good deal distressed if the rise of the steps exceeded eight or nine inches; whence it follows, that eight or nine inches is the extent to which the legs can be exerted with effect, whereas the hands can be effectually employed in a range certainly not less than three times greater. And as the motive-pressure must needs be inversely as the range in which it acts, it is impossible to discover wherein "this grand feature in the invention" of the wings being moved by the legs "renders it superior to all former attempts." Had S. R. practised the treadle-lathe and one turned by a handle, he would soon have perceived the superior efficiency of the hands. Indeed, the legs are not adapted to any thing that requires a powerful ascending motion; the angle formed by the thigh on raising the legs for a stroke, reduces their power exceedingly—whereas almost the whole body may move in aid of the hands, so that the exertion may be forcibly extended to a much greater distance.

Several years ago a gentleman of the name of Walker, a portrait-painter at Hull, conceived an idea of the possibility of flying. He published a short treatise on the subject, (some extracts from which appeared in the "Mechanics' Magazine" some time since) but which not exciting any one to the attempt, he determined to decide upon its practicability himself. He caused a car to be made three feet wide to sit in, with wings moving on joints, and firm supports for the feet to prop against, so that the whole body might be most effectually exerted in giving motion to a lever, standing up in the midst of the car at a convenient distance from the seat of the aeronaut, for him to lay hold of, and which was attached to both wings by connectors to an arm from the axis of the lever, which was placed at the bottom of the car. The wings were 12 feet long each, by about 6 feet broad, so that the extent of the machine was 27 feet. The mode of applying the power was undoubtedly as well devised as the thing would admit of; nevertheless, he was unable to raise himself from the platform on which the car was placed. The impossibility of flying by means of wings might, however, have been ascertained without trial. The effect of wings being most considerable near their ends, where the motion is greatest, and the more especially as the resistance is as the square of the velocity, we cannot estimate the point of central effect (or that point in which, supposing the whole resistance to be concentrated, the effect would be the same as if spread over the whole surface), at a less distance from the axis or joint of the wing than three-fourths of its length, viz. 9 feet: therefore, admitting him to pull the lever through a space of 2¼ feet with effect, then as such pull must needs be greater than the weight of the machine, and its contents in the proportion of 9 to 2¼, it follows that on a moderate estimate of his weight and that of the machine—say 2 cwt. in the

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whole—he must exert a force of 8 cwt. with a smart motion merely to lift himself and the car off the platform for a moment. The framing of the wings was partly of wood and partly of whalebone, and was closed with silk in narrow screeds with whalebone springs, to open for the air to pass through in their upward strokes. By the bye, it is a mistaken notion that the air passes through the feathers in the upward strokes of the wings of birds. Their flight being continued in a straight line, proves that their weight is sustained by their wings the same in their upward as their downward strokes. In the upward stroke, the after-edge of the wing being somewhat lowest, the rapidity with which they cut the air occasions it to bear hard underneath, by which the weight of the bird is sustained; and in the downward stroke, the after-edge being a small degree highest, necessarily propels the bird forwards, but apparently without increasing its support; since, in this situation, the air has a less tendency to bear against the under-side of the wing: and it is certain that were there the least difference in the weight sustained between the upward and downward strokes of the wings, birds could not keep a straight course, but must alternately rise and fall, which they are observed not to do. What then must have become of Mr. Walker during the time of raising his wings on the principle of letting the air pass through them in their upward strokes? Had he actually been aloft in the air, he must have descended a great distance ere he could have made a succeeding stroke! We know that there is no intermission in the action of gravity, and that the moment any thing ceases to be sustained, the same moment it begins to descend; and should it take only one second to raise the wings, he must in that interval fall 16 feet, abatement being made for the resistance of the air; if two seconds, then 64 feet, &c.

But Mr. Walker's wings were much too small to support a man in air; so that although there were really no want of power, they would have been found inadequate. The proof of this, however, together with the rest of my observations on S. R.'s production, must be deferred to another opportunity.

I am, Sir,
Yours, &c.
J. H.

Barton-upon-Humber.

MR. JENKINS'S PLAN FOR THE PROTECTION OF HOUSES FROM FIRE.

Sir,—I beg leave to forward to you an account of an apparatus for extinguishing houses on fire, proposed by Mr. C. E. Jenkins, of No. 33, Great Prescot-street, Goodman's-fields, Hon. Secretary to the Eclectic Society—of which he read a description and exhibited a model at the last meeting of the said society, on Tuesday evening, the 29th ult.

Mr. Jenkins commenced by remarking, that there are only two methods of extinguishing a fire; viz. either by excluding the atmospheric air, or by means of a plentiful supply of water; the first of these he considered as almost impossible to be brought into effect; and as to the latter, the manner in which the water is at present applied, is such that a very large quantity of it is totally useless, as every one must have observed who has attended a fire. The firemen of the different engines seem to have scarcely any idea of co-operation, for some are playing on the walls (which are generally nearly *fire-proof*), others through the windows, and others on the roof, from whence the water returns down the gutters, &c., by which means large quantities of it pass from the premises without having been of any service at all.

Mr. Jenkins's scheme for obviating these evils, consists in furnishing pipes from the ground-floor to the ceilings of every story of a house, and passing it round in a horizontal direction, nearly parallel with the walls, &c., of each room, the lower half of the horizontal portions of the pipe having numerous holes drilled therein. The number of revolutions of the pipe will of course depend on the size of the apartment; but Mr. Jenkins is of opinion, that for ordinary rooms, one would be sufficient. The manner in which these pipes are to be used is as

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follows:—Supposing a fire to have broken out on the one-pair story of a house, and an engine having arrived, the hose is to be screwed on to the bottom of the vertical pipe of the said story; as there is to be a separate pipe to *each story*, and the lower ends of the vertical pipes are to be bent at right angles, and finished with screws for attaching the hose from the exterior of the premises, the engine is then to be worked, and the fire thus exposed to the immediate action of the water (each room being, in fact, converted into a kind of shower-bath) would spedily be got under with much less trouble, and with the use of, at most, not above one-half the quantity of water that would be required to produce the same effect by an engine working in the common way; and if there was any thing like alacrity about the persons concerned, the two-pair story need not be even wetted.

Remarks.—The foregoing contrivance certainly does Mr. Jenkins much credit, and the model of it, which he exhibited, completely corroborated his statement; yet it will not, I believe, be ever brought into extensive use in dwelling-houses, for although the pipes might be concealed by a cornice, or something of a similar description, they would be rather awkward to repair, if they happened to get out of order, which they of course are likely to do; and the only method of ascertaining whether they were so or not would be by using them: an experiment of not the *most pleasing* kind in a bed-room, or any other room, which has furniture in it. Independently of which, few people, I suspect, would deem it worth while to apply it, as the expense of putting it up in a third-rate house, Mr. Jenkins considers, to be at least 20*l.*—a sum which not many persons would like to expend, on the remote probability of their houses being injured by fire in the course of ten or a dozen years, when the apparatus would perhaps be found out of repair; and even if it were in repair, it would be of *no use before the arrival of an engine.* In fact, Mr. Editor, I consider this scheme subject to nearly all the objections which have been expressed by several of your correspondents, with regard to "fire-escapes, &c.," to be fixed to, and form a portion of, the premises.

I am, Sir,
Yours, &c.
PIT.

July 7, 1830.

PROMOTION OF COMBUSTION BY EXHAUSTION.

Sir,—On perusing an article on the "Promotion of Combustion by means of Exhaustion," in the 358th Number of your Magazine, I am induced to hand you some particulars connected with the subject, in the hope that it may be the means of determining who was the first person that patented the invention, calculated to accomplish the combustion of fuel by the process of *exhaustion.*

So long back as the year 1821, I commenced a series of experiments, with a view to arrive at certain information relating to the ignition and combustion of inflammable substances, and for fuel in air-furnaces. The result was a determination on my part to secure by patent what I then considered a valuable invention, but more pressing pursuits prevented me carrying my project into effect till the commencement of the year 1823, and on the 12th of August following, the specification of the patent was enrolled, the heading of which ran thus:—"For certain improvements in the production of heat by the application of well-known principles, not hitherto made use of in the construction of air-furnaces of steam-engines, and of air-furnaces in general, whereby a considerable saving in the expenditure of fuel is obtained, and the total consumption of smoke may be effected." It is not my intention to raise a question of comparison between the merit of my invention and those of other projectors, who have since patented the very same principle in a modified shape, the *application* of which I claimed, as well as the hydraulic-machine, by which the object is effected. But a question of considerable importance to the parties interested in the matter may be raised, touching the validity of the claims and patents of Mr. James, Messrs.

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Braithwaite, Ericsson, and others, whose claims to the invention were not before the public till some years after my patent was sealed.

How far I am correct in my opinion, will be for yourself and your enlightened readers to judge, after having perused the following extract from my specification, to which I beg to refer for further detail:—

"The machine possesses the advantage of being able to consume the smoke, or, in other words, is capable of supplying any quantity of atmospheric air for the purpose, and that by two perfectly distinct modes of operation, which *I claim, independently of the machine*, as other machines, or the same, by modification, may produce the like effect. The first is by condensation, and the second by *exhaustion*; in the former case the machine revolves from right to left, and in the latter from left to right, or *vice versa*."

Well knowing the character which your Magazine possesses for the candid investigation and promulgation of facts, I doubt not but you will give an early insertion to the foregoing remarks, and by so doing you oblige,

Sir,

Your obedient servant,

G. H. PALMER.

No. 8, *Manchester-street,*
Gray's-Inn-Road,
July 6, 1830.

THE ANTIQUITY OF THE ART OF PAPER-MAKING.

It has been generally conceived that the first rudiments of the art of making paper, according to the process now in use, were acquired by the Arabians from certain Bukharian manufacturers, about the year 704, and by them introduced into Spain, in the eleventh century. We are, however, about to draw the reader's attention to a work which throws an entirely new light on the subject, and goes far to establish a remoter date. The conjectures of former investigators have been derived exclusively from a consideration of the *materials* employed by the ancients; but our learned friend, Musumeci, in his recent essay "On the ancient use of various kinds of Paper, and the art of making it,"* has taken up the subject on the only grounds from which clear and positive inferences can be drawn; he has inquired into the *mechanical means* by which those materials were produced, and instituted "a comparison of the process for making common papers, as now practised, with that which is recorded by the ancient writers." In doing this, he has also communicated the relative results of his researches.

Musumeci collects from Pliny*—the only one among ancient authors who treats at any length of the art of making paper—that there were seven distinct kinds of paper known in his time;—the *Hieratical*, or *Sacred* (afterwards called Augusta), which was of so delicate a texture, as to be ill-adapted to the purpose of the pen;—the *Amphitheatrical*, so called from the spot where it was manufactured, which was originally of very coarse quality, and fit only for common use;—the *Fannianal*, which was the same as the latter, but was ameliorated in quality by Fannio, from whom it derives its name;—the *Saitical*, first made in Sai, a town in Egypt, and composed of the vilest refuse—such as woollen rags, and the like;—the *Tenionical*, a coarse paper, resembling the bark of trees, valued more for its weight than its goodness;—the *Emporetical*, or *Emporical*, which was unfit for writing, but much used in trade;—and, lastly, the *Papyrus*.

We collect from the same authority, that all these kinds of paper corresponded, in a greater or less degree, with those of modern times; and that the present method of making them does not differ from the ancient. It is evident, therefore, that former inquirers, having erroneously considered ancient paper to be identical with papyrus, have been seduced into equivocal and ill-founded conjectures as to its nature. Now what does Pliny report? "Every sheet of paper is made from material in a damp state, composed of a substance derived from the fibres of vegetables; both sides being dried on a low table or superficies, of whatever length it is desired the form or frame of the paper should possess; the lattice (or wire) work is afterwards turned, and the sheet is complete." If it be added, that "the sheets are laid in a press, dried in the sun, placed together carefully with the most minute respect to quality, and sorted into bundles or quires,"—all

* Catania, 8vo. 1829.

* Nat. Hist. lib. 10. cap. xi. xii. et xiii.

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which operations are recited by Pliny, we can arrive at no other conclusion than what Musumeci has insisted upon; namely, that the process followed by the ancients is precisely analogous with that which is pursued at the present day. It appears, on further investigation, that the frames which the ancients used for their paper were not dissimilar to our own; that they were made of brass; and that the process of sizing was much the same; the dimensions as numerous; the uses as similar; and the defects as striking, as occur with our own papers. It is quite obvious from these facts, which rest equally upon Pliny's testimony, that paper itself, though styled "papyrus," was not a composition made with the small pellicles of the plant which bears that name, and glued together by the muddy waters of the Nile, as former interpreters have affirmed, but that it was manufactured under a process of maceration, whereby the pellicles were reduced to a pap; the only means capable of imparting to it that substance, whiteness, delicacy, &c., which Pliny so clearly indicates.

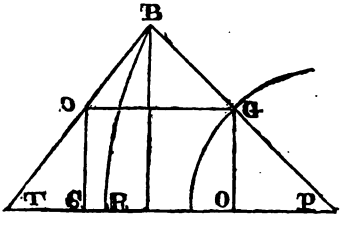
An indisputable proof of this fact exists in the papyri, lately described by Champollion, which cannot possibly have been formed by mere contexture, but must have been the result of maceration, and a fusion of the parts into one another. The same remark applies to the sort called *Saitical*, which Pliny states to have been made from rags and the vilest refuse. The process appears to have been known in times posterior to those of the Roman naturalist; for Cassiodorus, who lived at the Emperor Theodoric's court at Ravenna, when recommending paper-making to the assiduous attention of his contemporaries, makes special mention of maceration, but never of contexture. It should also be recollected, that, in Cassiodorus's time, five centuries later than Pliny's, Ravenna was celebrated for the manufacture of paper, which was composed of the *scirpus ravennatus*—in all probability, nothing more nor less than the common rush of our own rivers. Ginnani is of opinion, that this was the paper which constitutes the greater part, if not the whole, of the papyri now extant in the principal libraries of Europe: a circumstance which serves to strengthen the opinion many have entertained, that the papyri of Herculaneum were made of a pap, derived from the refuse of old leather, and capable, as results from repeated experiment, of resisting the effects of fire and water.—*Athenæum.*

METHOD OF GENERATING THE CONIC SECTIONS BY ONE INSTRUMENT.

Sir,—There have been several papers respecting the generation of each of the conic sections, inserted in your excellent periodical, but I do not recollect that any method has been offered for the production of all of them by one and the same instrument.

Mathematicians have turned their attention to this subject, and amongst the rest, Sir I. Newton has given a demonstration for the construction of such an instrument, which is, perhaps, the most elegant and simple of all that have been invented—an account of this may be seen in "Maclaurin's Algebra," part 2.

The general method, which I beg leave to propose, depends on the solution of the following problem. What is the nature of the curve produced by the continual intersection of the produced radii, PB, TB, of any two circles given in position and magnitude, the sine of the angle passed over by one radius being constantly equal to the tangent of the other (that is) GO=CS.



Let TR $= x$, BR $= y$, TS $= a$, PG $= r$.
PT $= c$.—Then by sim. tri.
TR : BR = TS :: CS,
or $x : y = a ::$ CS $\left(= \frac{ay}{x}\right)$ = GO.

Also, PB : PG = BR :: GO,
or $\sqrt{(c-x)^2 + y^2} : r = y :: \frac{ay}{x}$

$\therefore r^2 y^2 = (c-x)^2 + y^2 \times \frac{a^2 y^2}{x^2} \therefore$
$(r^2 - a^2) x^2 - a^2 y^2 + 2a^2 cx - a^2 c^2 = 0$,
an equation of two dimensions.

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Hence the curve is a conic section; and it will be a parabola when $a = r$, viz. when PQ = TS, an hyperbola or ellipse, according as PG is greater or less than TS (see Wood's Alg. part 2).

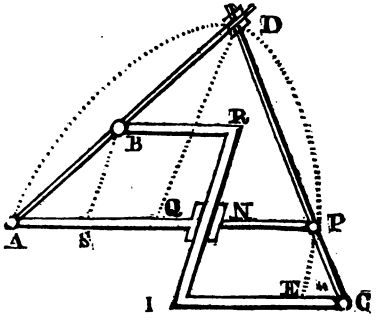
$$y = \pm \frac{\sqrt{(r^2 - a^2)x^2 + 2a^2cx - a^2c^2}}{a^2}$$

so that there are two equal values of y for each of x; the one positive, and the other negative: hence the curve is symmetrical on the axis PT. To find where the curve cuts the axis, put $y = o$, and we have $(r^2 - a^2)x^2 + 2a^2cx = a^2c^2$, a quadratic, solving which we have two values of x, that is, $x = \frac{ac}{r \pm a}$, and this for the parabola becomes $\frac{c}{2}$, and infinity.

In a similar manner, it might be shown that the curve would be a conic section, if CS bears any given ratio to GO.

How far it would be practicable to construct an instrument on this principle, I leave entirely to the judgment of your readers. Like all other methods that I know, it possesses this defect—the curve is produced by the intersection of two right lines, and the instrument will not work well when the angle of intersection is acute.

The following instrument, which is somewhat easier of construction, is for describing the parabolas and hyperbolas



only. The bar RI carrying the poles CD and AD, at the extremities of the arms BR, CI, slides in a groove at N in the fixed bar PA, the angles RNP being any given angle whatever. The rods CD, AD, have respectively an angular motion round the fixed poles PA, caused by the action of the moveable poles BC. The intersection D traces either the hyperbolas or parabola. Draw BS, DQ, and PE, parallel to RI. Let AS = a, CE = b, AP = c, AQ = x, DQ = y, RI = m. By sim. tri. AQ : DQ = AS :: BS, or $x : y = a :: \frac{ay}{x}$; also PQ : DQ = CE :: PE, or $c - x : y = b :: \frac{by}{c-x}$. By constr. $\frac{ay}{x} = m - \frac{by}{c-x}$ $\therefore$ $cay - axy = cmx - mx^2 - byx$; whence $mx^2 - (a-b)xy - cmx + cay = 0$, an equation of two dimensions belonging to the hyperbola, one of its assymtotes being parallel to DQ, when a and b are unequal, and to the parabola when equal; for then the term $(a - b)xy$ vanishes. Hence to draw a parabola, we must make SA = CE. In the case of the hyperbola, to find x when y becomes an assymtote, we have $y = \frac{mx^2 - mcx}{ax - bx - ac}$ which manifestly is infinite when the denominator vanishes, put $ax - bx - ac = o$ $\therefore$ $x = \frac{ac}{a-b}$. The curve cuts the axis when $y = o$, in which case the equation is, $mx^2 - mcx = o$ $\therefore$ $x = c$ and o, or the curve passes through A and P.

The construction of this instrument is, in fact, a particular arrangement or modification of a second general method of generating all the conic sections, described in "Maclaurin's Algebra." The chief advantage of it is, that while all the motions are simple, the angle of intersection for a very considerable portion of the curve remains nearly constant, and therefore the parts in action will have nearly an uniform pressure.

I will just remark that Sir I. Newton's instrument, above referred to, includes in its principles the parabolic trammel of Mr. Child as a particular case. Mr. C.'s instrument will generate hyperbolas whenever the angles TPD, BrT (see page 241, vol. xi.) are unequal, and the parabola when equal, whether obtuse, acute, or right.

The hyperbolic trammel, described at page 328, vol. xii. will also be found to be a particular arrangement

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of the one I have here secondly proposed; for we may imagine that the poles B and C are on the line RI, while AQ is infinite, when the two instruments are identical.

I am, Sir,
Yours, &c.
R. C., Jun.

June 7, 1830.

MR. ISAAC NEWTON'S SUPPLEMENTARY PROPOSITIONS ON HIS "APPENDIX TO EUCLID'S ELEMENTS."

Sir,—Some time ago I was induced to begin to study geometry, and accordingly procured a copy of Dr. Simson's "Euclid." I had not advanced beyond a few propositions in the first book, when, fortunately, a useful little work came into my hand, entitled "Appendix to Euclid's Elements; containing Original Propositions in Geometry, designed for the Young Student, as Exercises under the various Propositions in Euclid's Elements and Data. By Isaac Newton."* In the preface to this work, the author (who died in February 1827) observes, that in order to become a geometrician, it is not enough merely to read "Euclid's Elements;" the student must have something more on which to exercise his ingenuity. Geometry, like all the other mathematical branches, cannot be learned effectually without a due application of its principles to the solution of a sufficient variety of unwrought examples. It is on this account, therefore, that the following series of propositions have been composed for the young geometer, as exercises under the several propositions in "Euclid's Elements." Each of these (with the exception of the promiscuous) propositions, has prefixed to it the book and proposition of the elements from which it is derived.

Having no friend from whom I can obtain any assistance, I am often puzzled in my attempts to solve these exercises, with regard to the understood restrictions; and to deduce solutions to some of them from the corresponding propositions in the "Elements," has baffled my most earnest endeavours, though I have solved them independently of the propositions under which they are placed; but as such solutions evidently accord not with the design of the author, they are not satisfactory to myself.

I have observed in your valuable work, that other mechanics, when pressed by difficulties, have had recourse to the "Mechanics' Magazine" for assistance, and through the medium of its pages have received the required information. With the hope of similar indulgence, I respectfully solicit the favour of your inserting the following propositions, not doubting that some of the able contributors of your Miscellany will so far favour an unaided mechanic, as to show him how to deduce solutions from the corresponding propositions in the "Elements."

The first of the following propositions I am unable to solve without the aid of Proposition 32, Book 1, of the "Elements." The second I can solve only when the sum of either two of the required triangles is equal to the sum of the remaining two; and, I confess, I do not see the possibility of solving it *generally*. My solution to the last is deduced from Proposition 14, Book 2, Proposition 17, Book 6, and Proposition 23, Book 1.

Should I be so happy as to gain your attention, I conceive that other unaided students, using the same work, and, perhaps, stumbling at the same places, will feel their obligation to you, as well as,

Sir,
Yours obediently,
WILLIAM PEARSE.

Cawsand, Cornwall,
June, 1830.

1. Given the difference between the side and diagonal of a square to construct it, without the aid of principles ulterior to Proposition 23, Book 1, of "Euclid's Elements."

2. To divide a given parallelogram into four proportional triangles, having the ratios of any three of them given. The solution to be derived from Proposition 10, Book 6, Ibid.

3. Given the vertical angle, and the rectangle, and sum or difference of the including sides, to construct the triangle. The solution of this problem is required to be deduced from Proposition 23, Book 6, with strict regard to the *geometrical* principles of compound ratio.

The reader is requested to observe, that the idea of multiplication or division does not form any part of the first six Books of the "Elements."—*Wright's Exam. in Euclid.*

* Longman and Co., London, 1825.

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TAPLIN'S VERTICAL PADDLES.

Fig. 2.

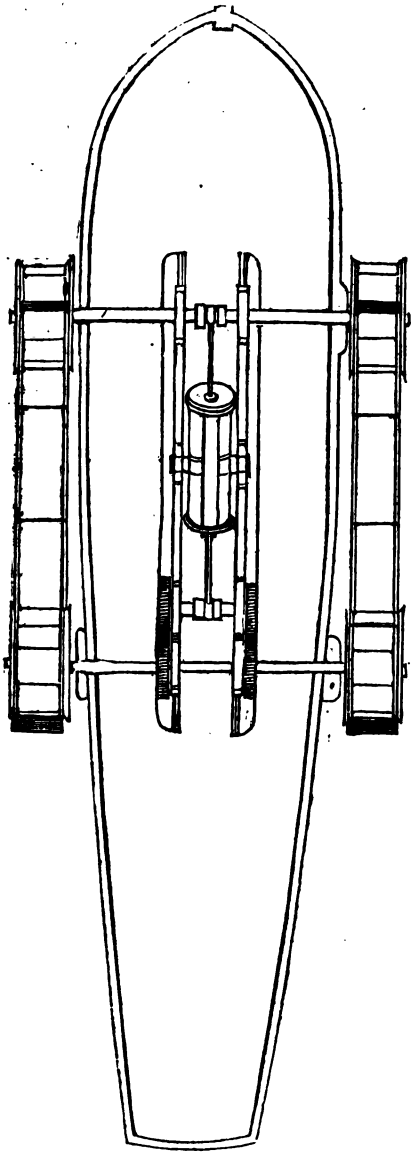
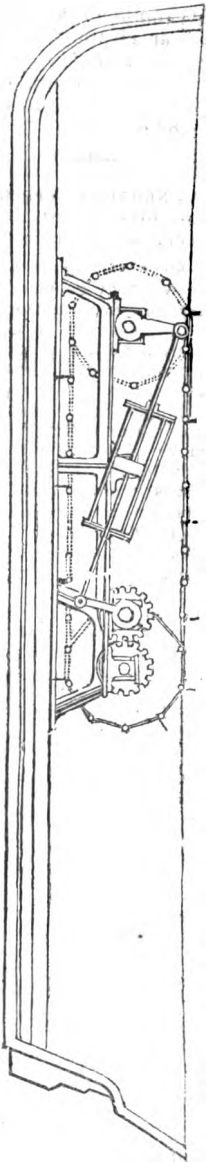


Fig. 1.



Portsmouth, March 20, 1830.

Sir,—The accompanying design or modification for propelling vessels having occurred to me a short time since, I beg to submit it for insertion in your useful Miscellany.

Yours respectfully,

ROBERT TAPLIN.

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It has long been a desideratum with machinists, and particularly those who constantly observe the operation of the present paddles, to change their form or mode of application; because, at present, a considerable portion of the motive force is wasted in the two actions, of immersing and withdrawing them from the water. This effect, may to a casual observer, appear to lift and depress the vessel accordingly, until it is considered, that while one is passing into, the other is coming out of the water; and that these causes, however opponent, are counteracting each other simultaneously. We infer, therefore, that as action and re-action destroy each other's effects, they are not immediately opposed to the advancement of the vessel. Yet there does exist a fact too firmly established to be refuted, that much of the disposable power of the engine is expended merely to produce these useless and wasteful results. There is but one paddle in the whole circumference of the wheel, and that but through a small space, acting favourably in the line of direction in which the vessel is moving—all the rest are either ascending or descending; while it is manifest that by the vertical paddle alone, the useful effect is produced.

The object of the accompanying modification, is to put into operation an indefinite number of vertical propellers, *by the simplest mechanical contrivance;* and which, by acquiring a continuous rectilinear movement, affords an opportunity of reducing the area of each. By this arrangement the ascending and descending surfaces absorb considerably less motive power: their vibratory effect on the vessel, so generally complained of, is diminished, and an increase of disposable power is acquired.

It is stated by a recent author, that if one-fourth of the steam usually employed were steadily applied in a horizontal direction, it would produce greater effects: should this assertion be the result of experiment, almost incalculable advantages, from the re-introduction of vertical propellers, may be reasonably expected.

A vibrating cylinder, with two piston-rods, working one through each end, steam-tight, and connected immediately to cranks, renders the engine one of the most simple, compact, and cheap, that can be employed for the purpose. The space the engine occupies is very trifling, the number of working parts being extremely few.

Fig. 1 is a section through the centre of the vessel and engine, showing the piston in the centre of the cylinder, and consequently at its half stroke. The piston-rods are secured to the piston, and are influenced entirely by its action, either end being supposed to follow the rotary movement of the cranks. But as these cranks will necessarily revolve in opposite directions, which will occasion a counteracting motion on the paddle-wheels, it is required that the motion of each wheel should coincide. This important object is fully accomplished by the introduction of cogged-wheels. From these explanations it is clearly demonstrable, that in the operation of the propellers, while the one wheel is stimulating, the other is drawing after it; thus an uniform revolution in the system is obtained.

The advantages to be derived from this species of propulsion are worthy of notice. The chain-wheels being smaller in circumference than the ordinary paddle-wheel, place the point of action nearer to the water-line. This arrangement may extend longitudinally to any assumed distance; by which means, in boisterous weather, it is not probable that the whole of the propellers will be disengaged from their work at one time.

A system of vertical paddles was projected some years since; but by what method they were put in motion, or in what way the machine was constructed, is rather problematical. In employing two cylinders to convey a reciprocating motion at two distinct points, which may have been the method resorted to, there is a liability of a diminution of effective power in one of the steam-cylinders, occasioned by an imperfection in the working parts; by which the whole of the machinery in the other must suffer retardation; having not only to work the paddles, but to assist in the operation of its coadjutor. If but one cylinder were employed to give effect to the arrange-

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ment, and the power of steam were applied only to one of the wheels, the chains to which the paddles are secured would have not only to draw the paddles through the water, but put in motion the opposite wheel; thus occasioning more wear and friction in the chains than the practical results of the present proportions are likely to occasion. It may be clearly seen that by applying the same power of steam to act simultaneously on both chain-wheels, no more than that of drawing the paddles through the water would be required of them.

Perhaps it will be unnecessary to enlarge on the precise manner in which the prime mover (steam) is to be generated, or on the method of applying it to put the engine in motion. Those who are acquainted with the principles of the steam-engine are perfectly aware that mechanical arrangements, simple in form and efficacious in application, may be easily resorted to for the purpose. These objects have been considered dispensable, and are therefore omitted.

R. TAPLIN,
Secretary to the Portsmouth, Portsea, and Gosport Mechanics' Institution.

ARITHMETICAL QUESTION.

Sir,—Perhaps some of your arithmetical correspondents will be so good as to decide the following question, which, although sufficiently simple to any one having a clear head for figures, has puzzled, in a most astonishing manner, several of my acquaintance; and among them some few who think themselves pretty considerable good arithmeticians.

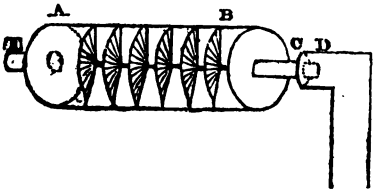
A merchant entering goods, to pay an *ad valorem* duty, at the Custom House, values them at £31 10*s*., their real value being £50, how much *per cent* does he undervalue them?

I shall also feel obliged if some of your arithmetical correspondents will state distinctly, whether it is possible to undervalue an article *more* than £100 *per cent*, and whether they think that any one, having laid a bet that it *is* possible, has the smallest shadow of an excuse for not paying the same. I send you a copy of the wager.

"I offer to stake——that it is impossible to undervalue an article more than 100 per cent (considered abstractedly and without reference to any use or custom)."

I am, Sir,
Yours, &c.
AN OLD SUBSCRIBER.

CYLINDRICAL-PUMP.



Sir,—Several years ago, I thought of a method of constructing a pump of which I now forward you the description. Fearing it might not so well answer in practice as it seemed to promise, I had lately thought but little of it, till I saw your notice of Cooper's rotary fire-engine, when it appeared to me to correspond exactly with the description of the engine, as far as the description was given; and as it appears that the projectors intend to secure the invention abroad as well as at home, I should be glad to secure it likewise *at home* by the publication of it in your Magazine, as it seems probable that the principle of each is the same.

AB is a cylinder, containing the worm of a screw, the outer edge of which is fixed to the cylinder so that they revolve together. The cylinder has a short pipe inserted at each end; the pipe C is inserted into a larger pipe D. It is evident, that if the cylinder is then made to revolve in the direction BC, the air will be driven forward from B to A, and expelled by the pipe E; consequently, there will be a current of air constantly passing through the cylinder; and if the pipe D be inserted into water, the water would be raised and expelled in the same direction, and with a force, in most cases, proportioned to the velocity of the revolution of the cylinder. This machine seems to correspond with every part of the description mentioned at p. 83, vol. xiii. namely:—

"That a continued vacuum is created and a continued discharge

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effected by one and the same operation.

"The air-vessel is totally dispensed with, and the power is applied directly upon the water. It operates on no more than it discharges; the current flows instantly, continuously, and uninterruptedly.

"A single revolution discharges the ice that may have collected on the surface exposed." This, however, must be, provided the ice is thin; it might not have occurred to the writer that the cylinder and pipes might be filled with a solid mass of ice.

The form in which I have represented it, though the best to explain the principle, is not the most advantageous, as by another method nearly half the friction might be avoided.

I am, Sir,

Yours, &c.

J. BARNARD.

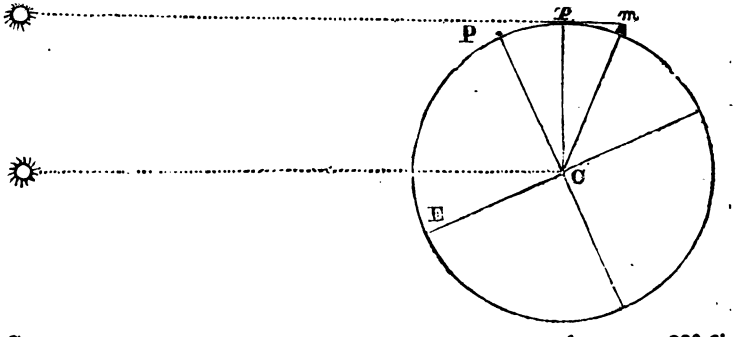
Bishop Stortford,
June 3, 1830.

ANSWERS TO THE QUESTION BY AMICUS, VOL. XIII. P. 7.

QUESTION. *There is a mountain in the north of Europe, whose perpendicular height above the level of the sea is* 5420 *feet; from the top of which, when the sun's declination is* 22′ 50″ *N. and on the meridian below the pole the lower limb is just in contact with the horizon. Required the latitude of the mountain, supposing the correction for sun's diameter, refraction, and parallax, is* 16′ 52″, *and the diameter of the earth* 7956 *miles.*

By Mr. Utting.

If the sun's rays passed to the earth's surface in straight lines, his centre would appear in contact with the horizon at a point on the earth's surface equal to his declination from the equator; or 22° 50′ above the North Pole (neglecting the sun's parallax). But by the question the sun's *lower limb* is in contact with the horizon. The apparent declination of the sun's lower limb will, therefore, be less by a quantity equal to his semidiameter, or about 16′. A reduction is also required for the sun's parallax of about 8″, whence 22° 50′ − 16′ + 8″ = 22° 33′ 52″. Now, as refraction causes objects to appear higher than they are in reality, we must increase this angle by a quantity equal to the horizontal refraction, or about 33′, whence 22° 33′ 52″ + 33′ = 23° 6′ 52″, or equal to 22° 50′ + 16′ 52″, as per question. This is the value of the *apparent* declination of the sun's lower limb when seen in the horizon by a spectator at *p*; *i. e.* a ray of light proceeding from the sun's lower limb would strike the earth's surface at a point 23° 6′ 52″ above the North Pole.



C ☉, represents the *true* declination of the sun's lower limb, as seen from the earth's centre = 22° 50′ — sun's semidiameter 16′ = 22° 34′. *m* P ☉, the *apparent* declination of the sun's lower limb, as seen from *m* = 23° 6′ 52″ + 7′ 6″ = 23° 13′ 58″. E, the equator.

To find the differences of latitude between this point and the top of the

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mountain at *m*, we have the earth's semidiameter $= \frac{7916}{2} = 3978$ miles $= 21003840$ feet $=$ CP, and $21003840 + 5420 = 21009260$ feet $=$ C*m*, the distance from the earth's centre to the top of the mountain. We have, therefore, two sides of a right-angled triangle, viz. the base and hypothenuse given, to find the perpendicular, or distance P*m*; and the angle or difference of latitude PC*m*, which on calculation will be found to be 477191 feet, and the corresponding angle $=$ 1° 18′ 5·37″ respectively. But these values must also be corrected for refraction; this, however, is of a different denomination, and is termed *terrestrial* refraction, in contradistinction to the former, which is usually called the *horizontal* (but may more properly be termed the *celestial*) *refraction*. Now, suppose a person to be placed beyond the limits of our atmosphere, a ray of light in passing the earth's surface from the sun to a spectator so situated, would undergo a double refraction; *i. e.* its value would be double of what we term the horizontal refraction. And in cases where a ray of light has to pass through a portion only (as P*m*) of the earth's atmosphere, a correction must be made proportional to the distance, in addition to the horizontal refraction as seen at P, as the path of a ray of light in passing through the atmosphere is concave towards the earth's surface in every part of its path. According to General Mudge, the terrestrial refraction amounts to about $\frac{1}{12}$ part of the distance of the object, (see Hutton's Course, vol. iii.) which in the present case must be applied *ad infinitum*, the sum of which series amounts to $\frac{1}{11}$. We must, therefore, add $\frac{1}{11}$ of the linear and angular distance to the above values, in order to obtain the situation of the mountain correctly.

Example.

Distance in feet P*m*	Angle PC*m*.
11)477191	
Increase of distance $=$ 43381*	11)1 18 5
	Refraction + ... 0 7 6*
True distance P*m* $=$ 520572	Angle PC*m* corrected $=$ 1 25 11
	Angle PCP $=$ 23 6 52
	Co-latitude $=$ 24 32 3
	Taken from 90 0 0
	Which gives the latitude of the mountain $=$ 65 27 57 as required.

Lynn Regis, May 29, 1830. J. UTTING.

By Messrs. Charles Hughes and Samuel Brooke, Pupils, Mansion-House, Hammersmith.

The radius of the earth being 3978 miles, and the height of the mountain 5420 feet $=$ 1·02651 miles ∴ the distance from the centre of the earth to the top of the mountain will be 3979·02651 miles; and by trigonometry the natural cosine of the dip will be $= \frac{3978}{3979{\cdot}02651} = {\cdot}9997420$ ∴ the dip is 1° 18′ 5″. Now, since the horizontal refraction corrected is always greater than the sun's semidiameter ∴ the sun's centre was 16′ 52″ depressed below the horizon of the top of the mountain ∴ 1° 18′ 5″ + 16′ 52″ $=$ 1° 34′ 57″ is the dip of the centre of the sun below the horizon of the bottom of the mountain. Then a $=$ altitude, d $=$ declination, and $90° + a - d =$ latitude (see p. 117 of Professor Inman's "Nautical Astronomy"). But as a in the given

* If 43381 feet, the $\frac{1}{12}$ part of 520572 feet, the *true distance*, be divided by 6109·77, the number of feet contained in one minute of a degree of a great circle, whose diameter is 7956 miles, we shall obtain 7′ 6″, (being the same as the latter part of our correction for refraction), agreeable to the rule as given at p. 142, vol. iii. of Hutton's Course. But it is evident, that the *preceding* process is much the easiest in the case to which it is applied.

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question is negative ∴ 90° − *o* − *d* = lat. = 90° − (1° 34′ 57″ + 22° 50′) = 65° 35′ 3″ N. required latitude of the mountain.

P. S.—It is not quite clear whether Amicus intended the correction, as stated by him, to apply both to celestial and terrestrial refraction, or to celestial refraction only. We have solved the question on the first supposition. But if celestial refraction was only intended, the true angle of dip will be 1° 18′ 5″ − $\frac{1}{12}$″ (1° 18′ 5″) = 1° 11′ 35″, and proceeding, as above, the latitude of the mountain will be 65° 41′ 33″ N.

CART-DRAGS.

Sir, — Your correspondent, Mr. Sims of Pwllheli's plan of dragging a cart down hill, is an alteration (I cannot say it is an improvement), on what has been used in the western parts of England, South Wales, and even in the city of Bristol, time out of mind; and which being extremely simple and cheap, may be worth describing.

An oak or ash pole, about 12 feet long, is carried in the cart in hilly roads; and at the summit of the hill to be descended, one end is attached to the axle, either by a hook or old halter (the halter most commonly). The cart is then tilted up until the whole weight rests on the pole, relieving the shaft-horse, who has nothing to do but to guide the cart.

As these hilly roads are generally full of ruts, and otherwise very rough, I conceive this plan much better than Mr. Sims's, which would not bear jolting.

When carts are constantly employed carrying lime, coal, slates, &c., they sometimes shoe the end of the pole with an old cart-streak; but this where wood is plentiful is looked upon as extravagance.

The whole apparatus would not cost a shilling in most parts of England; and as there are in all countries hilly bye-roads, it should be generally known.

Yours, &c.

B.

July 8, 1830.

New Food for Silk-Worms.—At a late meeting of the Royal Society at Lille, a letter was read from Clara Girodin, with which that lady transmitted samples of silk, produced in the years 1828 and 1829, from worms which had been fed wholly upon the leaves of the *Scorsonera*. She states that she could never discover any perceptible difference between the produce of worms thus treated, and those which were fed on the leaves of the white mulberry. The same changes and the same diseases affected either of them in an equal degree. M. Bosc also states, that the silk from the worm nourished with the *Scorsonera* leaf, was sold at Lyons for twenty-four francs per pound (or 19s.); within a fraction as high as the silk produced in the South of France. This discovery is highly important to all countries where the mulberry is of precarious growth.

Mr. Brunel.—"We believe it was under Earl Spencer's favour that Mr. Brunel's ingenious and valuable inventions in block-machinery were introduced into our dock-yards; together with many other improvements made in these important depôts, which have since contributed in no small degree to our naval superiority. We have heard it told as an anecdote (without being able to answer for its authenticity), that Mr. Brunel's fine device for cutting ship blocks was ultimately adopted from one of those chances which sometimes help clever men more than extraordinary talent and persevering industry. Like the generality of projectors who offer their schemes to government, he had, it is said, wasted many a day in fruitless endeavours to get his plans accepted and tried; at length, weary with deferred hopes, he presented a mechanical toy to Lady Spencer, into which a pack of cards being put, it could be so regulated as to deal them out to any number for a round game. The ingenuity of this trifle attracted so much notice, that the artist was immediately brought forward; and much of the rapidity with which future ships of war could be rigged and fitted for sea, was the result of a little box which saved fair dames the trouble of dealing cards for the amusement of a home circle!"—*National Portrait Gallery.*

INTERIM NOTICES.

We like J. S. A.'s plan, and shall be glad to have a specimen.

The information desired by Rintbury shall be furnished in our next.

S. Y. is requested to state in what respects the engraving already published is so defective as to make another necessary. We are not disposed to "refuse" any thing reasonable.

"Amicus," in reply to Cui Bono, next week.

A correspondent in Great Ormond-street, who complains of the "Mechanics' Magazine" having been made the medium of smuggling into his family a handbill announcing certain Sunday morning lectures, on "a new state of society, in which truth will be substituted for religion," &c., is respectfully informed that we have no control over venders in this respect. We can but regret, therefore, the improper use which seems to have been made of our work. No such bills were issued from this office.

Communications received from Mr. Franks—Mr. Thornton—A Constant Reader—Mr. Dudley—Mr. Maurice Garvey—Mr. J. Brown, Jun.—Mr. Harrison—Mr. Neilme.

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Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 363.] SATURDAY, JULY 24, 1830. [Price 3d.

What cannot art and industry perform,
When Science plans the progress of their toil?

BEATTIE.

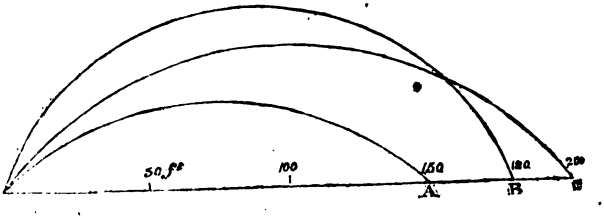
——— from the bounded level of our mind
Short views we take, nor see the lengths behind:
But more advanc'd, behold with strange surprise,
New distant scenes of endless Science rise.

POPE.

——— vast surveys and the sublime of things,
The soul assimilate and make her great.

YOUNG.

BRIDGE OVER THE DEE, AT CHESTER.



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ACCOUNT OF THE BRIDGE OVER THE DEE AT CHESTER, AND THE BRIDGE OF BRIOUDE—THE LARGEST STONE ARCH IN THE WORLD.

Sir,—I beg Mr. C. Davy's pardon for omitting the word "stone" in my former communication, and assure him the error was quite as unintentional as his omission of the word "elliptical." With this explanation he will allow that the bridge of Brioude has the largest stone arch in the world, and I readily concede that the middle-arch of New London Bridge is the largest elliptical stone arch in existence: I will go farther and say, that I doubt whether this bridge is not the noblest triumph of scientific architecture known. I have gazed upon it for hours with admiration and wonder, and am as proud of it as I should be of an Egyptian pyramid in the Regent's Park.

Herewith I send you a more particular description of the two famous bridges mentioned in my last, with a drawing of the one at Chester, copied, as nearly as possible, from the original in the "Companion to the Almanac," for 1830. If this drawing be correct, the arch is not elliptical, but forms part of a circle, and will have such an enormous thrust upon the piers as I fear to endanger its stability, except the foundations be rock. It would certainly gratify your scientific readers if any northern correspondent of the "Mechanics' Magazine" would inform them how far this work has progressed.

(*From the "Companion to the Almanac" for* 1830.)

"A new bridge, of a single arch, is in progress of erection over the Dee at Chester, The span of the bridge is 200 feet, being the largest stone arch ever built, the road-way 38 feet, the elevation from low-water mark 54 feet. The southern abutment is finished, and its wing-walls are nearly so; the northern abutment is in the front got up to the springing-course; its wing-walls are scarcely yet commenced, though the piles are now on the ground, and most of the stone is raised. Two of the four transverse walls for the support of the centre are built. This graceful edifice is one of the last designs of the late Mr. Harrison, of Chester."

(*From Rees' "Cyclopedia," article "Bridge."*)

"The bridge of Brioude is of great antiquity, and very remarkable as the largest stone arch with which we are acquainted. This bridge has only one arch, under which passes the whole stream of the River Allier. The arch is formed of two ranks of squared stones, all the rest of the fabric is rubble-work. The two extremities of the arch are founded upon the rock, which occasions the springing on one side to be higher than on the other; its span is 181 feet, and its greatest height from the water to the soffit of the arch is 68 feet, 8 inches; and the width of the bridge between the parapets is 13 feet."

I am, Sir,
An Old Reader, and
A LOVER OF LARGE ARCHES.

SOLUTIONS OF SIR ISAAC NEWTON'S ARITHMETICAL QUESTION, VOL. XII. P. 480.

QUESTION.—*If* 12 *oxen eat* $3\frac{1}{3}$ *acres of meadow in* 4 *weeks, &c.*

By G. S.

If 12 oxen eat $3\frac{1}{3}$ acres in 4 weeks, it is manifest that 24 or 36, &c. oxen would eat $6\frac{2}{3}$ or 10, &c. acres in the same time, whether the grass grows or not. And since $24 \div 3\frac{1}{3} = 7\frac{1}{5}$ and $12 \times 7\frac{1}{5} = 86\frac{2}{5}$. $\therefore 86\frac{2}{5}$ oxen will eat 24 acres in the same time that 12 oxen would eat $3\frac{1}{3}$ acres, and in the same way (since $24 \div 10 = 2\frac{2}{5}$ and $21 \times 2\frac{2}{5} = 50\frac{2}{5}$), $50\frac{2}{5}$ oxen will eat 24 acres in the same time that 21 oxen would eat 10 acres. The question may, therefore, be enunciated as follows:—

If $86\frac{2}{5}$ oxen eat up the grass on 24 acres in 4 weeks, and $50\frac{2}{5}$ oxen eat up the same number of acres in 9 weeks, how many oxen will the said number of acres suffice to feed for 18 weeks, supposing the growth of the grass to be uniform?

Solution.—$86\frac{2}{5} \times 4 = 345\frac{1}{5}$ and $50\frac{2}{5} \times 9 = 453\frac{1}{5}$. Now, it is manifest, had there been no growth, or had the grass ceased to grow at the end of the first 4 weeks, in either case the two above products must have been equal $\therefore 345\frac{1}{5}$ be taken as a measure for the quantity of grass at first on the

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acres, together with the growth for 4 weeks, $453\frac{1}{3}$ will be a measure for the quantity of grass on the same number of acres, together with the growth for 9 weeks $\therefore 453\frac{1}{3} - 345\frac{1}{3} = 108$, that is, 108 will be a measure for the increase or growth of the grass on 24 acres for (9—4) 5 weeks. Therefore, if 5 weeks give an increase of 108, 9 weeks will give an increase of $194\frac{2}{5}$ $\therefore$ since $453\frac{1}{3}$ is a measure for the quantity of grass at first on the 24 acres, together with the increase or growth for 9 weeks, and $194\frac{2}{5}$ is the growth for 9 weeks $\therefore 453\frac{1}{3} + 194\frac{2}{5} = 648$ will be a measure for the quantity of grass at first on the 24 acres, together with the growth for 18 weeks, hence $648 \div 18 = 36$ oxen.—*Ans.*

Otherwise generally.—Let P and q be two such numbers that Pb and qe may be each equal to g. Then it is obvious, if a oxen eat up the meadow b in the time c, aP oxen will eat up the meadow bP (g) in the same time c, for the same reason gd oxen will eat up the meadow qe (g) in the time f. $\therefore$ if aPc represent the quantity of grass at first on the meadow bP, together with the growth for the time c, qdf will be a measure for the quantity of grass at first on the meadow qe (g) together with the growth for the time f. Now, on the supposition that the grass did not grow, then aPc would be equal to qdf; but on account of the growth, $qdf - a$Pc will be a measure of the growth for the time $f - c$; and since the growth is uniform, the increase or growth for the remaining time $h - f$ will be found by the proportion $f - c : qdf - a$P$c :: h - f$:

$$\frac{(qdf - a\mathrm{P}c)\cdot(h-f)}{f-c} \therefore q\,df + \frac{(q\,df - a\,\mathrm{P}\,c)\cdot(h-f)}{\mathrm{F}-c} = \frac{q\,d\,f\cdot(h-c) - a\,\mathrm{P}\,c\cdot(h-f)}{f-c}$$

will be a measure for the quantity of grass at first on the meadow g, together with the growth for the time h $\therefore$ if x = number of oxen, then

$$hx = \frac{q\,d\,f\,(h-c) - a\,\mathrm{P}\,c\,(h-f)}{f-c}$$

hence

$$x = \frac{qdf\,(h-c) - a\mathrm{P}c\,(h-f)}{(hf-c)}$$

$$\text{In numbers} = \frac{21\times 9\times\frac{24}{10}\times 14 - 12\times 4\times\frac{72}{10}\times 9}{18\times 5}$$

$$= \frac{(21\times 14 - 2\times 72)12}{50} = \frac{25\times 72}{50}$$

$= 36$ oxen.

If for P and q we substitute their values, $\frac{g}{b}$ and $\frac{g}{e}$, the above formula becomes,

$$x = \frac{b\,d\,f\,g\,(h-c) - a\,c\,e\,g\,(h-f)}{b\,e\,h\,(f-c)}$$

which is the same as that of Sir Isaac Newton's.

Cor.—Hence $\frac{q\,d\,f - a\,\mathrm{P}\,c}{f-c}$ will be the number of oxen that the growth of the grass alone on the meadow g will suffice to feed $= \frac{21\times 9\times 24 - 12\times 4\times 72}{50} = 21\frac{1}{5}$ oxen.

G. S.

By Mr. Wm. Russel, Kilburn.

12 and $3\frac{1}{4} \times 3 = 36$ and 10 respectively, consequently 36 oxen will eat 10 acres in 4 weeks; but 21 oxen will eat 10 acres in 9 weeks. Now, 36×4 and $21 \times 9 = 144$ and 189, which products would have been *equal* had the grass *not* grown. The *increase*, therefore, in 5 weeks (9 — 4) will be represented by 45 (189 — 144): hence the increase for the remaining 9 weeks (18 — 9) will be 81, for $\frac{45}{5} \times 9 = 81$ $\therefore$ $189 + 81 = 270$, which represents *the quantity of grass with its increase* on 10 acres in 18 weeks: hence $\frac{270}{18} = 15$, the number of oxen which will eat 10 acres in 18 weeks $\therefore \frac{15}{10} \times 24 = 36$ oxen.—*Ans.*

Keith has given a neat solution of this question, and likewise a *general* one, using the notation of Sir Isaac Newton. Hewitt has also given a solution of it in his Key to Walkingame's Tutor's Assistant. Indeed, al-

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most every country schoolmaster has his own particular mode of solving this question.

By Mr. Samuel Latham, Birmingham.

I shall first take the arithmetical question, which will perhaps be better understood if given as under:—"If 12 oxen eat up $3\frac{1}{3}$ acres of grass in 4 weeks, and 21 oxen eat up 10 acres of as good pasturage in 9 weeks, supposing the grass to grow uniformly during the last 5 weeks the oxen are feeding, how many oxen would eat up 24 acres in 18 weeks, supposing the grass to grow in the same proportion during the 14 last weeks in the meadow of 24 acres as it did in that of 10?"

If $3\frac{1}{3}$ acres would maintain 12 oxen for any given time, 10 acres would maintain 36 for the same time, for

acres. oxen. acres. oxen.
$3\frac{1}{3} : 12 :: 10 : 36$

and if 10 acres would maintain 36 oxen 4 weeks, it would maintain 16 oxen for 9 weeks, for

weeks. oxen. weeks. oxen.
$4 : 36 :: 9 : 16$

inversely, or 8 oxen for 18 weeks, supposing the grass did not grow during part of the time, but the grass growing during part of the time the oxen are feeding, it requires 21 oxen to eat up 10 acres in 9 weeks instead of 16; therefore, the growth of the 10 acres of grass during the last 5 weeks has been sufficient to feed 5 oxen for 9 weeks, or $2\frac{2}{9}$ oxen for 18 weeks. And in 14 weeks (the excess of 18 above 4) the grass growing in the same proportion would feed 7 oxen more in 18 weeks than it would if it did not grow at all, but the growth of the grass during the last 14 weeks was sufficient to feed 7 oxen more, 10 acres would feed 8 + 7 or 15 oxen 18 weeks. Then, if 10 acres would feed 15 oxen 18 weeks, 24 would feed 36 the same time, for

acres. oxen. acres. oxen.
$10 : 15 :: 24 : 36$

It will be found by inspecting Sir Isaac Newton's algebraical analysis of the question, that he supposes the grass not to grow at all during the first 4 weeks in either of the meadows, and the ratio of its growth during the latter weeks is found from the second supposition.

The following is the algebraical solution:—

acres. oxen. acres.
$b : a :: e : \frac{ac}{b}$ } in the time c,

oxen. time. oxen.
$c : \frac{ae}{b} :: f \frac{cae}{bf} = \frac{ce}{bf} a$ in the time f,

oxen.
$c : \frac{ae}{b} :: h : \frac{ce}{bh} a$ in the time h will eat the pasture e time $f - c$. Or,

If b acres maintain a oxen for the time $c - e$ acres will maintain $\frac{ac}{b}$ oxen for the time c; for $b : a :: e : \frac{ae}{b}$.

And if e acres feed $\frac{ae}{b}$ oxen for c weeks

oxen.
they would feed $\frac{aec}{bf}$ in the time f, for

oxen. oxen. oxen.
$c : \frac{ae}{b} :: f : \frac{aec}{bf}$ inversely, or $\frac{aec}{bh}$

the time h. But the grass growing during the time $f - c$, it requires d oxen to eat up the pasture e in the time f; therefore, the growth of the grass during the time $f - c$ has been sufficient to maintain the oxen $d - \frac{ace}{bf}$ for the time f, or the oxen $\frac{fd}{h} - \frac{ace}{bh}$ in the time h; for

$$f : d - \frac{ace}{bf} :: h : \frac{df}{h} - \frac{ace}{bh}$$

inversely, and if the growth of the time $f - c$ be sufficient to feed $\frac{df}{h} - \frac{ace}{bh}$ oxen for the time h, the growth of the grass in the time $h - c$ would feed the oxen $\frac{bdfh + aec^2 - aceh - bcdf}{bhf - bch}$ for the time h; for $f - c : \frac{df}{h} - \frac{aec}{bh} :: h - c : \frac{bdfh + ace^2 - aceh - bcdf}{bkf - bch}$, which

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added to the oxen $\frac{aec}{bh}$ will give $\frac{acef + bdfh - ecah - bcdf}{bfh - bch}$ the number of oxen the pasture e would feed in the time h, and if the pasture e would feed $\frac{bdfh + acef - aceh - bcdf}{bfh - bch}$ the pasturage g would feed the oxen $\frac{bdfgh + acefg - acegh - bcdfg}{befh - bceh}$ during the time h; for,

$$e : \frac{bdfh + acef - aceh}{bfh - bch} - bedf :: g : \frac{bdfgh + acefg - acegh - bcdfg}{befh - bceh}.$$

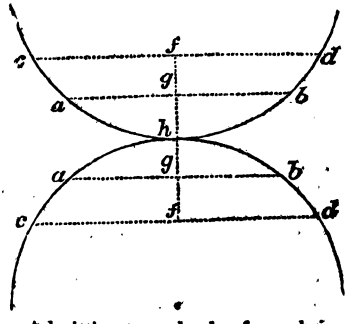
EPICYCLOID AND INVOLUTE TEETH.

Sir,—Pursuant to my promise at page 167 of your 353rd Number, I now proceed to show the quantity of sliding in the teeth of wheels, and to compare epicycloid and involute teeth. Had it been that *a certain point* in the driven tooth was acted upon from that point in the arc where the contact of the teeth begins to their arrival at the line of centres, and then that a *certain point* of the driver should act against the other until their separation, as is shown (No. 319, page 238), would be the case if the teeth were not rounded off; then the *quantity* of slide, both on entering in and coming out, might be clearly perceived. But straight teeth being incompatible with an equable motion, cannot be admitted; and yet such teeth would slide the least possible, because the length of their surfaces is not increased either by curvity or obliquity.

Now as an equable motion is of the most indispensable necessity, and can only be obtained by giving curvature to the teeth; so because curvity and obliquity are inseparable, and both increase the length of surface, and consequently the quantity of sliding or friction, it follows that the most perfect form for teeth is that which will produce equable motion with the least curvity and obliquity.

In teeth formed to produce equable motion, the parts in contact change continually in both teeth; but this does not annihilate the sliding or even lessen its quantity; it only renders the quantity more difficult to determine by observation, although it is really greater than if the teeth were straight. The sliding is exceeding observable in the small model with involute teeth, which I sent to convince "S. Y." (an engineer), who ignorantly persisted in insisting that involute teeth "have little or no friction." He has given a sketch of this model, No. 353, page 168. There is, however, evident data from whence the quantity of slide and consequent friction may be demonstrably shown.

The quantity of *direct* sliding in the teeth of wheels is, in fact, clearly determinable from the quantity of the arcs through which the contact of the two wheels are continued—the direct slide being, in all cases (i. e. whatever the form of the teeth may be), as the distance they enter into each other after the touching commences, and the distance they come out again before they separate or cease to touch each other. But the *real* slide is not merely these distances—it is increased by the difference between these distances and those measured along the surfaces of the teeth as far as they come in contact with each other; the former being a straight line tending directly to the centre, and the latter, in some degree, both circuitous and oblique.



Admitting two wheels of equal size and the contact of the teeth to be continued through the arc $a\,b$, so that the touching extends to an equal distance on each side of the line of centres; then the direct slide of the teeth

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of each wheel in going in will equal *h g*, and in coming out will also equal *h g*, the whole being equal to the distance *g g*. If the contact be continued through the arc *c d*, then the direct slide of the teeth of each wheel in going in and in coming out will each equal *h f*, the whole slide being equal to *f f*. If the contact of the teeth begins at *a* and ends at *d*, then the direct slide in entering will equal *h g*, and that in coming out will equal *h f*. And this direct sliding in and out (being the versed sines of the angles *a h* and *h d* in each wheel) must inevitably remain the same, whatever form may be given to the teeth; but *the real slide* in each wheel is greater than those distances directly, as the acting surfaces of the teeth are longer than those direct straight lines. A *bow* must needs be always longer than a *chord*, and an *oblique measure* always greater than a *direct measure*; and it is obvious that the continual divergence of the curvature gives a bow at the same time, that it also necessarily lengthens the acting surfaces by the same principle that the hypothenuse of a triangle is longer than the perpendicular; whence the quantity of slide, or friction, is consequently increased from both these causes.

Now *epicycloidal* teeth have the least possible quantity of sliding consistent with an equable motion; being curved only one-half their depth of action, the rest being part of a straight line proceeding direct to the centre of the wheel: wherefore the sliding of this part is merely that occasioned by the direct motion in and out, without any addition; whereas *involute* teeth are curved throughout their whole length. This of course must, of itself, render the acting surfaces longer than the epicycloid, the half of which only is curved. But when it is *besides* considered that the obliquity increases more and more rapidly as the curvature is continued through a greater space, it becomes manifest that such continually increasing declination necessarily augments the obliquity to a much higher degree, which extending the surface of the teeth very considerably, evidently increases the quantity of sliding arising from this cause, in the same proportion, at the same time that it is also increased by the greater arch of the surface.

But this is not the worst. Involute teeth act obliquely throughout, even in the line of centres (see the drawings No. 344, page 23, and No. 353, page 168); and it need not be told that the pressure required to produce a certain effect must needs be greater, as the force acts in a more oblique direction to the motion it imparts; whereas, *epicycloidal teeth continually act precisely in the direction of the motion of the driven wheel*, as may be perceived from the drawing, "S. Y." has given in No. 359, page 283:* a line proceeding from the centre of the driven wheel, being always a tangent to that part of the curve which is in contact with it throughout all angles in which the contact of the teeth may be continued, so that the effect is produced by a *minimum* pressure of the teeth against each other. Thus epicycloidal teeth have both *a minimum pressure* and *a minimum quantity of slide*.

But involute teeth have yet another great defect. The acting surfaces of the teeth, in both the wheels, are convex, so that the pressure is necessarily sustained by less portions of the surfaces; and it must needs follow that the *gripe* is just as much greater in proportion as the quantities of surface in contact are less; whence the wear of the teeth is inevitably greater from this cause, as well as from the greater pressure which their oblique action occasions; besides also throwing a greater pressure on the gudgeons or pivots. On the other hand, the epicycloidal curve always acts against the straight part of the other tooth; and I apprehend no one will question but that the quantity of surface in contact must be greater when one of the surfaces is straight than when both are convex.

Yours, &c.

JAMES HARRISON.

Barton-upon-Humber,
July 9, 1830.

P. S.—It is almost time to take

* In which the dotted form of the epicycloid appears to be tolerably correct, but the shaded part is ill-formed.

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"S. Y." (our engineer) aback. I pledge myself to show that his remarks (as he calls them) on my papers abound with gross misrepresentation, and that almost the whole are fallacious. And I, perhaps, may also point out some instances of *unfairness*, as well as *want of truth*, not altogether creditable to him. I need not inform your readers that I have no pecuniary interest in this matter, and that it cannot make any difference to me were the epicycloid to be applied by no other person than myself (although it may doubtless be applied by numbers of mechanics), neither do I argue for the sake of conquest. I profess to be actuated by the interest of truth; and I wish to insist on what I know to be so, not only by the clearest theoretic demonstration, but by long experience.

ANSWERS TO THE ARITHMETICAL QUESTION IN LAST NUMBER.

Sir,—In your last Number a question is asked, Is it possible to undervalue an article 100 per cent.?

Yes. In 1672, by the *addition* of farthings to the numerary, the lowest price for *all* articles was undervalued 400 per cent.

In 1793, the French lowest price was undervalued 600 per cent, as

100 pence = 1,000 centimes, or milliemes, or *cash*.
100 pence = 400 farthings.

600

The lowest bidding for tea at Canton is 1 cash.
In London . . . . . 1 farthing.

There are 12 tales or Chinese ounces of 1,000 cash each to the pound avoirdupois.

Another question is asked as to the difference per cent. between an *ad valorem* duty at £31. 10*s.* and the real value at £50, as

£100
63

17 per cent. The *real* value of either import or exports cannot be anticipated. It cannot be determined in Thames-street what merchandise shall sell for at Canton, otherwise than as your youngest boy, the "Boston Mechanicks' Magazine," would say, "by a pretty considerable good guess."

I am, Sir,
Your very obedient servant,
T.

July 19, 1830.

Sir,—In answer to the "arithmetical question" of "An Old Subscriber," in No. 362, of the "Mechanics' Magazine" of July 17, perhaps the following may be satisfactory.

First Question.—A merchant who enters goods, to pay an *ad valorem* duty, at the Custom-house, and values them at £31. 10*s.* their real value being £50, undervalues them £58. 14*s.* 7*d.* $\frac{1}{1000}$ per cent. Because the test of valuation by the Custom-house is to put 10 per cent. on the *valuation given*, and seize the goods, paying the amount of course. Now, the amount in the above case, undervalued, being £18. 10*s.* is equal to £58. 14*s.* 7*d.* $\frac{1}{1000}$ per cent. on £31. 10*s.*

Second Question.—"Abstractedly considered, and without reference to any use or custom," an article may be undervalued more than 100 per cent. Because, by the proposition, there can be but one test—the value given. Now, if I value an article at £20, which is afterwards proved to be worth £100, I undervalue that article 400 per cent., inasmuch as £80, the amount undervalued, is £400 per cent. on £20, the amount given.

Had the question run thus, "If an article be valued at £400, it is impossible to undervalue it more than £100 per cent," the proposer would have been correct.

I am, Sir,
Yours, &c.
No Tyro.

Maidenbury,
July 19*th*, 1830.

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THE CAMERA LUCIDA.

Sir,—Upon reading the excellent description of the camera lucida, in your 336th Number, I was induced to purchase one, and was greatly pleased to find that its powers had by no means been exaggerated by your correspondent, H. J. of Exeter, to whom I return my sincere thanks, for having introduced to my notice so pleasing and useful an instrument.

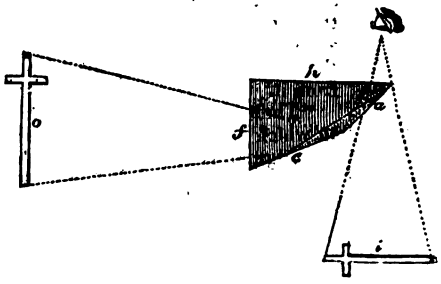
In the description above alluded to, it is said, "the eye-hole is to be so placed, that half of it is over the prism, and half over the paper." This requires modification. If the strength of light which falls upon the object to be drawn, and that which falls upon the tracing-pencil, *is equal*, then the eye-hole may, as above, be cut by the prism exactly in the middle.

But, if the light upon the object is more intense than that which falls upon the pencil, the sliding-plate must be drawn a small distance farther back, to render the pencil visible. Or, if the light which falls upon the pencil is the strongest, then the sliding-plate must be pushed more forward (*i. e.* farther over the prism), in order to make the object more distinct. I mention this circumstance, because I experiencedsome little difficulty on first using the instrument, from not being aware of the necessity of thus attending to the proper distribution of the light.

As the principle upon which the action of the camera lucida depends has not yet been described in your pages, I have selected the following from the treatise on optical instruments published by the Society for the Diffusion of Useful Knowledge:—

"The camera lucida of Dr. Wollaston consists of a quadrangular glass prism, by which the rays from an object are twice reflected: its form is shown in fig. 1. The object *o* to be traced, is opposite the perpendicular surface of the prism *f*, and the rays proceeding from *o* pass through this surface, and fall on the inclined plane *e*, making an angle with *f* of 67½°: from this they are reflected at an equal angle to the plane *a*, making an angle of 135° with *e*, and are again reflected to the eye above the

Fig. 1.



horizontal plane, which makes an angle of 67½° with the last reflection. The rays of light from the objects proceeding upwards from *a* towards the eye of the observer, the observer will be led to imagine the image at *i*, and by placing the paper below in this place, the image may be traced with a pencil. In order to increase or diminish the size of the picture, the prism is mounted in a brass frame supported by brass tubes, capable of being drawn out or shortened at pleasure.* The picture always bears the same relation in size to the object, as the distance from the eye to the image or paper is to the distance from the object to the eye; hence by lengthening the tubes, the drawing is increased in size: it should be remarked, that by this prism no real image is formed, but it always appears as far below the prism as the object is before it. The brass-frame of the prism has usually two lenses, one concave and the other convex; the former to be used in front at *f* for short-sighted persons, the latter turned up underneath the prism for long sights.

"The periscopic principle of Dr. Wollaston has been applied to this instrument, by forming the upper surface at *h* slightly concave.

"Various modifications and contrivances have been adopted to improve or construct different kinds of camera lucidas for tracing or delineating objects. A very simple one may be made with a plane reflector, either of speculum-metal or plate-glass, having its face inclined at an angle of 45°; but in this form, as there is only one reflection, the drawing or tracing,

* See vol. xii. p. 353.

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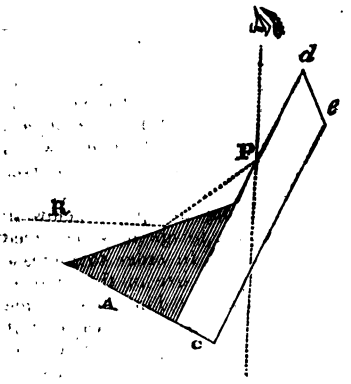
will have those objects on the left side, that in the original object are on the right side, in the same manner as an engraved plate for printing is the reverse of the impression taken from it.

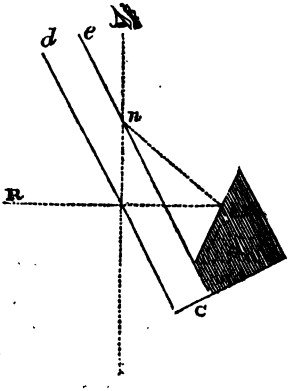
"The most ingenious camera lucida, in which the tracings are similar to the original, is shown in fig. 2, which

Fig. 2.



consists of a parallel piece of plate glass *de*C, connected to a reflecting speculum A. In this instrument, the invention of S. Amici, the rays from the object R are thrown on to the speculum A (inclined at an angle of 135°), and reflected by it on to the plate-glass at P, and from thence to the eye above. The instrument is mounted in brass, and has a rectangular opening at the top, whereby the eye is prevented from seeing a reverse image of the objects produced by the metallic mirror. Another construction, which Amici esteems the best, is shown in fig. 3, where the rays are made to pass through the plate-glass before they impinge on the mirror A (as shown by the dotted lines), they are then reflected to *n*, and from thence to the eye; one-half of the pupil being directed through the glass, *de*, C, to the paper below, and the other half receiving the reflected rays."

Fig. 3.



I am, Sir,

Yours respectfully,

WM. BADDELEY, Jun.

Sir,—In compliance with the request of "B. C.," page 240 of the 89th Part of your Magazine, I have carefully tried the Camera Lucida with a two-foot rule, and find the divisions are represented equally correct, when shown of half the size, equal size, and *double the size* of the original. I may observe, however, that the utmost steadiness of head is required to obtain this great exactness; but can assure "B. C.," or any other person, that if they fail in obtaining it, the reason is precisely what I have stated. It requires, indeed, more steadiness to effect this, than to measure the angles of a chrystal with the Doctor's reflecting goniometer; an instrument which resembles the Camera Lucida in several respects, besides that of being admirably adapted for the purpose for which it is intended. Observe, the eye should be placed as close to the glass prism as possible; and in looking at the *ends* of the scale, the head should not be turned, but a certain oblique ocular survey (commonly known by the name of *ogling*) should be made use of. And in order to prevent the slight motion of the head, which is apt to take place, the olfactory organ may be delicately placed in contact with the brass adjusting screw of the prism. But although I am satisfied that this excellent instrument will stand the test proposed by your correspondent, yet I may be allowed to observe, that for all *ordinary* purposes this extreme

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minuteness is no more necessary than the plan I have heard recommended of trying a gun with three or four charges of powder, a handful of bullets, besides a wadding of dry clay, and all this in order to find out whether the said gun was safe, and fit to be used for ordinary shooting.

But I will occupy no more of your valuable space; I have contracted the above from a much more voluminous account, and which might have suited your first volume well enough, but, *tempora mutantur:* and I have only to add, that this is the *last* inquiry I shall answer upon this subject. The instrument appears, as far as I can observe, to be *perfect;* the purchase-money is no ruinous consideration, and your correspondents may procure it for themselves, and verify my assertions to satiety; but I do not see why I should be continually called upon (as in the case of phrenology, for example, of which I am pleased to observe a clever defence in your new Periodical) to prove what every *sensible* man has full power to prove to himself, if he will but take the trouble. In conclusion, I may state that the instrument will be made much more generally useful by the addition of a portable tabular support, elevated upon three jointed legs, by which means it may be set down and used in the fields, &c. These stands I have seen so constructed, in the shops of several of the London opticians.

I am, Sir,
Yours, &c.
H. J. not H. G.

Exeter, July 17, 1830.

CYLINDRICAL-PUMP.

Sir,—Mr. Barnard's cylindrical-pump (see p. 333) does not, as he supposes, correspond with every part of the description of Cooper's rotary fire-engine, given at p. 83 of the present volume.

In that description it is intimated that the whole contents of the cylinder are discharged at each revolution; and, according to the account of its performances, it must do even more than this, for in a No. 7 engine the revolving-cylinder is said to be 12 inches long and 6½ inches diameter; its cubical contents will therefore be something less than one gallon and a half; and this engine is said to deliver 304 gallons of water at every 100 revolutions, that is, upwards of 3 gallons, or twice its cubical contents, at every revolution!

Mr. Barnard's pump, on the contrary, will only deliver (*pardon the supposition*) the quantity of water contained in one circular thread of the helix, *i. e.* (there being 6 threads) about one-sixth of the contents of the cylinder at each revolution.

But I have here, for the sake of argument, supposed the form of pump designed by Mr. Barnard to be *capable*, whereas, in fact, it is *totally incapable*, of acting; completely realizing the fears expressed by Mr. Barnard at the outset of his communication.

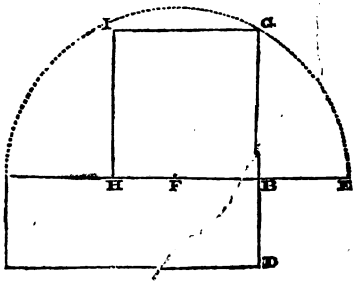
While in a *horizontal* position, this pump will neither create a vacuum nor raise water; to become effectual, it must be inclined to an angle of from 45° to 60° with the horizon, and its lower end immersed in water; in which form it is neither more nor less than the hydraulic-screw of Archimedes, invented about 2000 years ago, a description of which may be found in almost every work treating of the science of hydraulics.

I am, Sir,
Yours respectfully,
Wm. Baddeley, Jun.

July 19, 1830.

SQUARING THE CIRCLE.

Remarks on Major-General Ouseley's Construction.



Sir,—It is *well known* to geometers that the area of a circle is equal to that of a rectangle contained by the

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radius, and a straight line equal to half the circumference. Whence to construct a *square*, that shall be equal to a given rectilineal figure (Euclid, Prop. 14, Book 2); let ABCD be the given rectilineal figure, "equal to the area of the circle;" it is required to construct a square that shall be equal to AD. Produce AB to E, and make BE equal to BD; bisect AE in F, and from the centre F, with the distance FA, or FE, describe the semicircle AGE; produce DB to G, wherefore BG is the side of the square required: make BH equal to BG, and we have two sides of the square given HBG, being a right angle; it only remains to make HI, IG, also equal to BG, or BH, and the square IB will be equal to the rectilineal figure AD, or to the area of the circle as was required.

Now the above construction is evidently shorter than that of the General's, as the lines KI and KG, in the General's figure, are dispensed with in the above construction; in lieu of which it is only necessary to produce AB to E. Besides, in the above figure we have HBG a right angle, and consequently the position of the sides HB, BG, given. Whereas in the General's construction, we have one side only, viz. GK, given in position.

Again, supposing a cylinder to be accurately constructed, how is it to be divided into two *precisely equal* parts? Is the circumference of the cylinder more *correctly* or *neatly* defined by *notches* made at the extremities of its diameter, or by a fine line engraved on its circumference, agreeable to the method which I proposed (vol. xiii. page 165), as it is the *area* which is to be defined, and not the circumference only? In the General's construction (vol. xiii. page 251) it may be observed, that if a line be produced from B through K to L, the position of KL will be determined. Now as the triangle BKG is described in a semicircle, BKG is a right angle. And as GKL must also be a right angle, the sum of the two angles is equal to 180 degrees; consequently BKL is a right line.

In conclusion I would ask, "where is the *novelty*, or to what does this supposed discovery amount?" As it is after all, even admitting it were *new*, a *geometri-mechanical* construction only, as I before observed. A purely geometrical one cannot be effected until a right line can be found *geometrically*, that is equal to the semi-circumference of a circle.

It is asserted in the "Ency. Britannica," vol. ix. page 656, sixth edition, that the approximation of the circumference to the diameter of a circle, has been carried as far as the 150th place of decimals. Now I am not aware that it has been carried farther by any one than by M. de Lagny, who computed the ratio to 127 decimal places.

The construction, as given by Cui Bono, may be found in vol. i. page 350, of Hutton's "Recreations;" in which volume, page 293, may also be found a solution of a *variety* of cases relating to Mr. Lucock's mechanical exercise.

I am, Sir,
Yours, &c.
J. UTTING.

Lynn Regis, June 16, 1830.

Sir,—There certainly cannot be a question of Major-General Ouseley's method being quite as accurate as the several formulæ in practical use, and neither more nor less so; for it is but a corollary from a geometrical proposition, which supplies the method of multiplying the circumference by half the radius for the area; upon the demonstration that a circle is the same as a triangle, whose base and altitude are equal to the circumference and radius of that circle, or to the rectangle formed by the circumference and one-fourth of the diameter. Every rectangle, of course, is equal to the square of a mean proportional between its two sides; and, therefore, this method of the General's is an understood deduction from geometrical reasoning of more than 2000 years date: and affected in common with every attempt that has been (or I apprehend ever will be) made to square the circle, by the desideratum of the exact proportion between the diameter and circumference.

The formulæ $d^2 \left(\frac{1}{28\frac{1}{4}}+\frac{3}{4}\right)$ or

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$\left(\frac{4}{113}+\frac{3}{4}\right)d^2$ are merely vulgar fractions substituted for a decimal one; for the area of a circle, whose diameter is one, is of course ·78539, which is exactly equal to either of the above fractions. And as the contents of any circle may be found by multiplying the square of the diameter by the decimals ·78539, because similar superficies are to each other as the squares of their homologous sides; so must either of the General's formulæ give the same result as would $d^2\left(\frac{71}{90,4}\right)$ or $d^2\left(\frac{1}{113}+\frac{63}{90,4}\right)$ and, indeed, many other methods that might be contrived in the same manner; but none of them possessing the smallest practical value, as differing nothing in result from, and being much less convenient than, the usual mode of multiplying the square of the diameter by ·78539 or ·7854.

I am, Sir,
Yours, &c.
A Constant Reader,
NAUTICUS.

Sir,—Having replied to Cui Bono's first objection to General Ouseley's method of squaring the circle (page 251, vol. xiii.), Cui Bono, in reply to the same, has started two objections (page 288). First—he says, "When the General divides the cylinder longitudinally, does he effect it by means of a saw of some thickness, or of one indefinitely thin, &c.?" If Cui Bono will again examine the General's second construction (page 251), he will find that the cylinder is not supposed to be divided into two equal parts, and that the notches cut out at A and B, form no part of the revolving semicylinder BCA.

Cui Bono's second objection is rather singular. He says, "The surface of the cylinder and the plane on which it is to roll must either be perfectly smooth or not. In the latter case, the figures, are not perfectly geometrical figures but mere approximations. In the former case, it would be impossible to perform the operations of the slipperiness of the

On stating the above objections to the General, he remarked—'then they will not allow me what Euclid is obliged to suppose a perfect *plane surface;* and with regard to the slipperiness of the surfaces, instead of a semi-cylinder, we may substitute two vertical semicircles, revolving on a fixed axis, passing through their centres.' Thus referring to the General's figure (page 251), the points B and G are given in position. The other corresponding points in the opposite revolving semicircle are not seen in the figure, but are also given in position. Thus we have four points given in position; and if Cui Bono will allow us to make use of Euclid's first postulate, these four defined points may be joined by straight lines, which will form a rectangle; and hence a square may be described equal to the given rectangle.

Cui Bono says, in his first communication on this subject (page 164, vol. xiii.), that the General's method is *mechanical.* Well, if every proposition, whose solution requires the aid of matter and motion is mechanical, so must the General's. But I will ask Cui Bono, how are we actually to join two points by a straight line, describe a circle, construct a triangle rectangle square, &c. If this is done by means of any machine—if by manual or instrumental operations, the term mechanical would appear as applicable to such operation as it might to the General's contrivance. But Cui Bono would, no doubt, in answer to this, refer me to Euclid's three postulates. In conclusion, I will say, that I consider that, in a practical way, the General's problem can be as accurately constructed as any problem in Euclid. Let any one compare the simple method of the General, and that of performing the same problem by means of that indescribable curve, the quadratrix.

I am, Sir,
Yours, &c.
AMICUS.

June 27, 1830.

AMICUS' ASTRONOMICAL QUESTION.

Sir,—I return my best thanks to Mr. Utting, and to Messrs. C. Hughes

and Brookes, of the Mansion-house School, Hammersmith, for the pains they have taken in solving my astronomical question. I am sorry, however, to observe that they do not agree in their answers, which is caused by the way in which they apply the effects of terrestrial and celestial refractions. If Mr. Utting will again examine the matter, he will find that he is mistaken in taking the sum instead of the difference of the two refractions.

I am, Sir,
Yours, &c.
AMICUS.

July 18, 1830.

REPLY TO MR. HARRISON ON DRURY'S IMPROVEMENTS IN BELL-RINGING.

Sir,—"If by the *Editor's* leave, and yours, good people, I may be heard, I'd crave a word or two; the which shall turn you to no further harm than so much loss of time."—*Shakspeare.*

It is always with regret that I see your pages made the vehicle of useless discussion; and that regret is still more poignant on finding *myself* involved in a controversy of this description.

Not to occupy your columns with unnecessary quibbling, I pass over the remarks of Mr. Harrison at page 294, again referring him to mine, in No. 355. Suffice it for me to say a few words in reply to the question of Mr. Harrison. "Do I arrogate to myself the exclusive privilege of communicating projects—or suppose, that because I have mentioned a new scheme any one else is prevented from mentioning a better?"

I shall dispose of this question by stating, that whenever I may publish in your pages any description of what I consider new or ingenious contrivances, I shall esteem it a particular favour if any of your numerous readers will describe a better.

Had Mr. Harrison confined himself to this, we had not stood in our present relation to each other. In that gentleman's letter, at page 163, fifty-seven lines are occupied in ridiculing and running down the inventions of a rival tradesman; and only fifteen lines in allusions to (*not descriptions of*) another plan, said to surpass them.

It is a common saying, "comparisons are odious;" they are, however, particularly so, when drawn in the style adopted by Mr. Harrison.

Now, Sir, if it is not drawing too largely upon Mr. Harrison's stock of information, I will thank him for a sketch and description of the "tolling-hammer," referred to at page 163; and if it sustains the character which Mr. Harrison has given to it, I can assure him I am sufficiently unprejudiced duly to appreciate its merits.

In the description of Drury's improvements, inserted in No. 331, I only compared them with our usual modes of ringing in London, not being aware of the existence of "tolling hammers." And although I cannot at present perceive how a hammer, under the circumstances mentioned by Mr. Harrison, can produce *the full effect* of a bell, yet I am willing to learn.

I remain, Sir,
Yours respectfully,
WM. BADDELEY, Jun.

GUERNSEY INVENTIONS—BREAD-MAKING MACHINE, AND SAFETY WINDOW-SHUTTERS.

Sir,—In Part 88 of your excellent Magazine, which is only just now come to my hand, I observe the description of a machine, now exhibiting in the National Repository, for kneading dough, which induces me to send you an account of one for the same purpose, which has long been in use at the General Hospital, in Guernsey; much simpler in its construction, and if we may judge from the bread made by it (for I had not an opportunity of seeing it at work), and by the account given of it by the conductors of that admirable institution, answers the purpose *completely*. I intended to have sent you a sketch of it some months ago, but a variety of occupations have caused it to be delayed; but as it is so exactly like a machine generally known in this country, but used for a different purpose, it may not be necessary—I

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mean the mill used for grinding the clay for making bricks. It is, in every respect, exactly like that in shape and construction, with the addition only of a flat piece of iron attached to the shaft, and passing down almost close to the barrel, for the purpose of clearing the dough from the sides as it passes round. The size of the machine (which I did not measure) may be about three feet in height, two feet in diameter at the bottom, and eighteen inches at the top. The shaft, which carries the irons for working or kneading the dough, has an iron bar, eight or nine feet long, attached to it at top, and is turned by two men, walking round like horses in a mill; but it might easily be made to act by a winch and two wheels, and be turned with moderate exertion by one man, or by any other kind of power. The machine is fixed in the bake-house; the bottom of it on a level with a large trough, in which the dough is prepared in the usual way; it is then put into the machine at top, and is delivered through a hole, about four inches long and one high in the side of the machine, into the said trough, ready for making up into loaves for the oven. The bread was excellent.

If the above description should not be sufficiently explanatory, I shall be happy to send you a sketch at a future time.

As I am writing, I will endeavour to discribe another contrivance, which I noticed in Guernsey, and is worthy of imitation. Arriving at St. Peter's on a Sunday, the shops were all shut up, and I was struck with the appearance of almost all the shop-shutters, and during my stay, examined their construction; they are much more compact, and a far greater security against thieves, than any I have seen in this country, and very superior to those described in the "Register of Arts" some time ago.* Two, three, or more irons, according to the height of the window, and degree of security required, are constructed with joints or hinges, about six inches from each other, and as long as the window is wide; upon these series of hinges the shutters are nailed or rivetted; small rollers are inserted into their lower ends, and there is a piece of sheet-iron, or iron-hoop, in the grooves on which they run. The lower series of hinges has a rack attached to it as long as the window is wide, in which a pinion, of about six teeth, works; this pinion is fixed inside the shop at the end of the rack farthest from the window, and its axis made so long as just to be flush with the drawers or shelves, and is turned by a winch with ease by one hand. A space, little more than the thickness of the shutters, is left between the drawers or shelves and the wall, with a groove for the shutters to be drawn into in the day-time.

By this contrivance the shutters of a large window may be driven out or drawn in with ease by one hand, and the shop completely shut up or opened in half a minute: those which I examined were secured by the drawer at the end of the rack, being pushed in about an inch (the thickness of the rack), so that the end of the rack abutted upon it, thus rendering it impossible to force the shutters open by any instrument outside. Most of the windows, especially if very wide, are made not quite flat but a little bowing—the segment of a large circle—and the shutters are generally reeded, so that the divisions are not perceptible, and they look very neat. In fact, their appearance and mode of action are exactly like the circular fronts of the secretaries and bureaus in common use.

I am, Sir,
Yours respectfully,
MILIWAL THIGNK.

Chelmsford, June 26, 1830.

* We presume the writer alludes to Smith and Dow's metallic shutters.—EDIT.

MR. WALKER'S FLYING APPARATUS.

Sir,—Being one of those who, as well as Mr. Harrison, was favoured with an inspection of Mr. Walker's flying apparatus whilst building, I beg to offer a few observations on the subject. The inventor is a gentleman of great talent, and very unassuming, although highly communicative. I can readily imagine, however, that he would be reserved even before men of ingenuity, calculated to appre-

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ciate so extraordinary an undertaking; and still more so in the presence of the critic, the wit, or the more heavy part of mankind, who are too tiresome to instruct. Those who saw the model when it was finished (for it was only a slight fragile machine for an experiment) expressed their great astonishment, and were confident of its answering the intended purpose. The wings were allowed to be large enough, and there was sufficient power to work them; but an alteration to make the power more compact was deemed desirable. It was in the year 1810 this experiment was tried; a time when our country was nearly distracted with politics, rather than engaged in cultivating the arts and sciences; and there was not a single spirited individual to come forward with any pecuniary assistance in so certain and grand an undertaking. About two years since, I had the pleasure of seeing Mr. Walker in town, when I was delighted to hear that he had made some improvements, and that his plan might be demonstrated at pleasure.

As the treatise is out of print, very scarce, has created considerable interest throughout Europe, and is of the greatest importance to facilitate the attainment of the object in view, I hope you will for the gratification of your numerous readers, give place to the following short extract from the author's work:—

"I beg also to remind such of my readers as doubt the possibility of flying, that many useful and valuable mechanical inventions, which are now rendered complete, and become common, would a century or two past have been treated as visionary and impracticable. My invention for attaining the art is founded entirely upon the principles of nature; and although these principles are as old as the creation, they have never until now been properly attended to. The study of the works of nature has been to me, during the greatest part of my life, a source of amusement and inexpressible delight. The natural history of birds has particularly occupied my attention; and that enviable faculty which they possess of flying has greatly excited my curiosity, and led me to that study by which I have obtained a *true knowledge* of the mechanical principles by which they fly. How much are we indebted to the study of nature for discoveries of the greatest importance? and from this delightful study many more are yet to be expected. I have long been accustomed to contemplate a bird as a living machine, formed by the Almighty Creator, either to run upon the earth, to dive in the waters, or to ascend into and fly through the air; and when I examine its various parts, and find such an exquisite display of wisdom, in each being formed so perfectly to answer the use it is applied to; when I see the effect of the whole, that such a wonderfully organized, animated piece of matter can quit the earth and soar aloft in the air, it appears to me a miracle, and I am struck with admiration. It is now almost twenty years since I was first led to think, by the study of birds and their means of flying, that if an artificial machine were formed with wings, in exact imitation of the mechanism of one of those beautiful machines, and applied in the very same way upon the air, there could be no doubt of its being made to fly; for it is an axiom in philosophy, that the same cause will produce the same effect!"

I am, Sir,
Yours, &c.
G. W.

Regent-street.

NEW QUESTIONS. BY MR. UTTING.

1. If a solid globe of silver be cased over with gold an inch in thickness, its diameter is required, supposing the quantity of the metals employed to be each of equal value, admitting the gold to be worth £3. 15*s.* and the silver 5*s.* per ounce; their specific gravities being $17\frac{1}{8}$ and $10\frac{1}{2}$ respectively?

2. Having the sum of the sides, the sum of their differences, and one side of any rectilineal given; to determine the triangle?

3. If lines are drawn from the three angles of any plane triangle bisecting the opposite sides, the distance from the angles to the common point of intersection will be double their complement; and the several parts into

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which the triangle will be thus divided; will each of them be of the same area. Required a demonstration?

MISCELLANEOUS.

Encroachments of the Sea.—In Clew Bay, on the western coast of Ireland, there was formerly an island, called Minisb, the surface of which, in the reign of Charles I., was twelve acres in extent; as is proved by several public documents of that period. On being measured in the year 1814, it was found to be only 420 feet long, and 30 broad. In 1816 it entirely disappeared. The Island of Clare, in the immediate neighbourhood, furnishes another example of the destructive action of the sea on those coasts. Bounded every where by cliffs of immense height, it is continually corroded by the ocean, which has worn deep caverns; into which, when agitated, it throws immense blocks of stone, detached from the cliffs, with a noise that is quite appalling.

To prevent Milk becoming Sour.—To prevent milk from turning sour and curdling, as it is so apt to do in the heat of summer, the milk men of Paris add a small quantity of sub-carbonate of potash or soda, which saturating the acetic acid as it forms, prevents the coagulation or separation of curd; and some of them practise this with so much success as to gain the reputation of selling milk that *never turns.* Often when coagulation *has* taken place, they restore the fluidity by a greater or less addition of one or the other of the fixed alkalies. The acetate which is thus formed has no injurious effects, and, besides milk, contains naturally a small quantity of acetate of potash, but not an atom of free or carbonated alkali.

Preservation of Butter.—M. Thenard recommends the method used by the Tartars; which consists in fusing the butter in a water-bath at a temperature of 190° Fahr., and retaining it quiescent in that state, until the caseous matter has settled, and the butter become clear; it is then to be decanted, passed through a cloth, and cooled in a mixture of salt and ice, or, at least, in spring water, without which it would crystallize, and not resist so well the action of air. Preserved in close vessels and cold places, it may be kept for six months as good as it was on the first day, especially if the upper part be excepted. If, when used, it be beaten up with one-sixth of cheese, it will have all the appearance of fresh butter. The flavour of rancid butter may, according to M. Thenard, be removed almost entirely by similar meltings and coolings.—*Quarterly Journal.*

The Spider.—Leuwenhoeck has found that the threads of the smallest spider, of which some are not as large as a grain of sand, were of such a fineness that it would be necessary to unite more than four millions to form the thickness of a hair. Now we know that each one of this series is already composed of four thousand threads; it follows then that sixteen million of these threads, drawn by the little spider, have not together the thickness of a hair.

Remarkable Phenomenon in a Medicinal Compound.—M. Ehrenberg, apothecary at Cannern, having, agreeably to the prescription of a physician, made a solution of acetate of potash in cinnamon water, found, twenty-four hours afterwards, that the solution exhaled a decided odour of prussic acid. Thinking that some mistake had been made in the preparation, he renewed it and obtained the same result. M. Blei, apothecary at Pemberg, has also confirmed the fact.

Observations on the Evaporation of Ice, by M. Schuebler.—It results from these observations that the evaporation of ice is much more considerable than is generally imagined, and that under certain circumstances, it may surpass that of water. In a dry cold air on the 9th of January, the evaporation from ice in twenty-four hours, was twice as great as from an equal surface of water in the middle of February, during mild and cloudy weather. We may perceive from this the manner in which snow disappears gradually by long exposure to a cold atmosphere.

Iron Furnaces in England and Scotland.—The number of high furnaces in 1740 was but fifty-nine. This number has been increased as follows:—

1740,	59	furnaces	producing	17,000 tons.
1788,	85	..	..	68,000 ..
1796,	121	..	..	125,000 ..
1806,		..	..	250,000 ..
1820,		..	..	400,000 ..
1827,	284	..	..	690,000 ..

Of the two hundred and eighty-four furnaces last mentioned, ninety-five are in Staffordshire, and ninety in South Wales.

Artificial Dove.—The environs of Florence owe their beauty to a race of farmers, who are industrious and liberal. On Easter eve I remarked a crowd of these farmers collected in the Cathedral of Florence, which just as the priests began "Gloria in Excelsis" burst away from the choir, glided among the nave, set fire to a combustible car in the street, and then flew whizzing back to its post. The eyes of every peasant were wistfully rivetted on the sacred puppet, and expressed a deep interest in its flight, for till then hopes of a future harvest depended on its safe return to the altar.—*Correspondent of the Bury Herald.*

INTERIM NOTICES.

Part II. of the "Spirit of Literature," price 1*s.* next Magazine-day. Also Part XC. "Mechanics' Magazine" (including five Numbers), price 1*s.* 3*d.*

We have received towards the close of the week a number of answers to the arithmetical question in our last Number, in addition to the two inserted in our present Number; but have not yet time to ascertain whether any of them are preferable to those now published.

Communications received from Mr. Baddeley—Vulcan—J. B. Jun.—Navigator—Astra—Nicholas—W. Lever—An Aged Mechanic.

Erratum.—P. 279, col. 2. l. 18. for 30lbs. read 300lbs. In the logarithmic calculation the fraction ½ is misplaced—it ought to have been two lines lower down, viz. against log. 40459, which is half of 80919 next above, or in the third row, being the difference of the two first logarithms. Though half the difference of the logarithms gives half the proportion, yet perhaps the fraction would have been better omitted. My reason for giving the logarithms was to show the great ease with which the calculation is effected thereby.—J. H.

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Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 364.] SATURDAY, JULY 31, 1830. [Price 3d.

LONDON BRIDGE ARCH OVER THAMES STREET.

Fig. 1.

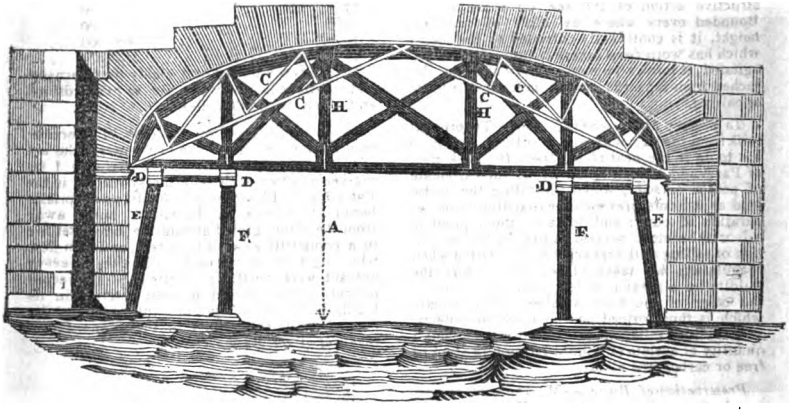


Fig. 2.

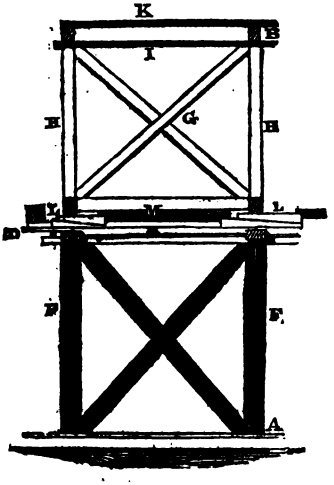
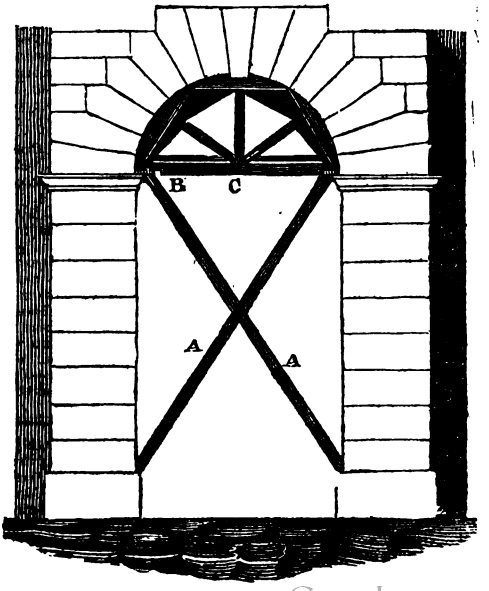


Fig. 3.



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DESCRIPTIVE ACCOUNT OF THE PRINCIPAL BRIDGES ERECTED OVER THE RIVER THAMES. BY MR. C. DAVY, ARCHITECT.

No. XVI.

Ceremony of Laying the First Stone of New London Bridge—The Centering and Arch over Thames-street.

The first coffer-dam of New London Bridge was on the 15th day of June, 1825, the scene of a grand pageant. The ceremony of laying the first stone (as it is called) was performed in the presence of an immense concourse of spectators, comprising a goodly representation of the rank and fashion, wealth and industry, of the east and west ends of the City. The many memorable associations connected with the old structure no doubt increased the interest felt in the event by the citizens of London. The removal of an old bridge of such extent, and the erection of a new one, is a sort of revolution of rare occurrence, and whether we consider, scientifically, the magnitude of the present undertaking, or the improvement likely to be effected in one of the most crowded and busy portions of this city, the circumstance was well worthy of being marked by some degree of splendour.

From the ballusters of the old bridge an opening was made leading by a temporary flight of steps immediately to the coffer-dam, the whole space being covered over with a canvass awning, decorated with flags, pendants, &c. All the vessels in the pool had also their streamers flying topmast high. The interior of the coffer-dam was divided into four tiers or galleries, along which several rows of benches, covered with scarlet cloth, were arranged for the benefit of the spectators. The floor of the dam, 45 feet below the high-water mark, was also covered with scarlet cloth, except in that part of it where the first stone was to be laid.

On the City side of the old bridge a barrier was erected to prevent confusion from the crowd accumulating on the bridge previous to the time appointed. At twelve o'clock this was thrown open, and remained open till two, when it was again closed until the procession arrived. The public were admitted within the barrier by tickets only, and the whole space was densely occupied. At this time the scene was greatly enlivened by the performances of two bands of the Horse Guards (Red and Blue), and the band of the Artillery Company. At three o'clock a signal-gun announced that the procession had left the Mansion House, and shortly after immense cheering in the vicinity of the bridge announced its arrival. The City watermen first entered the dam with the flags and banners of the principal City Companies, followed by his late Royal Highness the Duke of York, the Lord Mayor, the Aldermen, and Common Councilmen, Earl of Darnley, the Right Hon. C. W. Wynn, M. P., Sir G. Cockburn, M. P., Sir R. Wilson, M. P., and many other distinguished persons, including a splendid assemblage of ladies. After the national anthem had been sung by the charity children belonging to Candlewick, Bridge, and Dowgate Wards, the Chairman of the Bridge Committee came forward, and in the name of the Committee requested of the Lord Mayor that he would lay the first stone of the new bridge, and presented him with a splendid silver-gilt trowel* to perform the ceremony. An excavation had been previously made in the stone, and four glass cylindrical supports 7in. × 3in. imbedded in plaster, for the purpose of supporting the depositum-plate. Specimens of all the coins of the reign of George IV. were first enclosed in a cut-glass bottle, and the whole deposited in the excavation. The plate was then fixed on its glass supports. The stone weighed nearly 5 tons, of Aberdeen granite. It was lowered to its situation precisely at five o'clock P. M. amidst deafening cheers and the roar of artillery. Two blocks of granite of similar size lay beside the first stone, and the three are covered by an immense mass of Haytor granite, weighing upwards of 8 tons. The cere-

* Thompson's "Chronicles of London Bridge" contains highly interesting views of the coffer-dam as it appeared when fitted up, as also a print of the superb trowel that was presented to Alderman Garratt and used on the occasion.

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mony being ended, the distinguished party were entertained in the evening by the Lord Mayor at the Mansion House. The inscription on the plate has been given in a former paper, and this account has been reserved for the present time as a supplement to our account of the construction of the coffer-dam. I shall now resume my course of architectural description, by inviting attention to the centering of the arch over Thames-street.

There are many claimants for the honour of first suggesting this arch, but it may be sufficient for the present* to say, that that suggestion has been acted upon, and the arch is now in a very forward state. To the eternal disgrace of the parties concerned in the rebuilding of London Bridge, the approaches to it, though among the most important considerations connected with the business, were scarcely thought of till the bridge-works had advanced so far that farther delay would have perhaps proved ruinous to the whole concern. As it is, the sacrifice of property has been frightful, if we consider the cost at which it has been effected, as well as the three expensive alterations of the works. At no distant period we shall have to compare the estimate with the real cost; the whole transactions, from beginning to end, may then be fairly canvassed and disposed of according to their deserts.

The arch (see fig. 1) is a very flat ellipse, and extends across the road and pathways of Thames-street, bounded on either side by lateral entrances with piers, &c., as shown in fig. 3. The centering (fig. 1) is on the same principle as those used in the large arches; it is mainly and independently supported by the struts and uprights EE and FF, allowing sufficient room for carts and foot-passengers to pass and repass Thames-street as usual. Each pair of principals belonging to the centering rests upon the wedges LL, fig. 2, (which is a section taken through the line AB, fig. 1) the wedges are kept apart and in their places by the piece of timber M, notched down upon the wedges LL; now, by removing M, the wedges can be withdrawn and the centering lowered.

CC (fig. 1) is the mould for forming the true curvature of the planking on which the voussoirs rest; DD ends of the longitudinal timbers, wedges, &c., shown at DLM (fig. 2).

HH (figs. 1 and 2) are the queen-posts; the intervening spaces longitudinal with the arch and parallel with these posts only, are filled with cross-bracings, as shown in the section (fig. 2). To prevent the pressure of the voussoirs from distorting the centre, the head and feet of the queen-posts are secured with pieces of timber laid longitudinally immediately under the joggles of the cross-braces; one of these pieces is shown at II (fig. 2). The centering of the lateral arch (fig. 3) is supported by cross-braces AA resting upon the plinth; the other parts BB and C answer the same purpose as the wedges, &c. described in fig. 1.

The observations made on the subject of centering in papers, Nos. 9, 10, and 11, are perfectly applicable to the one now before us; this being the case, I shall dispense with farther remark on the arch over Thames-street for the present.

(To be continued.)

* The next paper will contain a general review of all the plans suggested to avoid Fish-street-hill, &c.

ARCHIMEDES' SCREW.

Answer to the Question by Κρόνος, vol. xiii. p. 7.

Sir,—In the solution to the above question I assume the inclination of the cylinder to the horizon to be 45°, and the diameter of the cylinder = 12 inches; from which it is required, as per question, to find the *vertical* distance between two threads of the coil or pipe, so that water may just be raised by it to the top.

In order that the above conditions may obtain, it is requisite that the angle included between the base of the cylinder and the horizon should be equal to the angle subtended between the base of the cylinder and the central line of the spiral; "or the inclination of the axis of the cylinder from the vertical, must be equal to the angle which the convolutions

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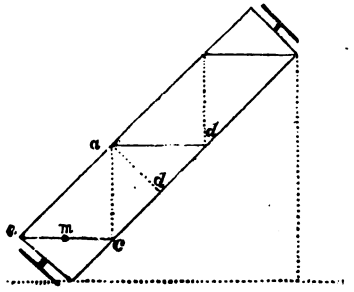
of the spiral, or pipe, make with the base of the cylinder." In which case the coil of the pipe on what may be termed the *ascending* side of the cylinder will be parallel to the horizon; and a body placed at the *mean* point of *inflection* (as at *m*) will have no tendency to move one way more than another, supposing the cylinder to be at rest. But if the cylinder be turned on its axis in one direction (as from *c* to *e*), the body so placed will move the contrary way (from *e* to *c*), in conformity with the well-known laws of motion, and the water in the present inquiry will ascend to the top of the cylinder; "as the pipe which conveys it makes it rise more in consequence of the rotary motion of the cylinder, than it descends by virtue of the force



of gravity." Now, as the angle *abd* =angle *bad*, it is evident that *bd*= *ad*=12 inches, whence *bd* × 2=*bc*= 24 inches; therefore, as ∠*cab*, or sin. 90° : *bc* :: sin. ∠*abc* 45° : *ac*=16·97 inches, the vertical distance between the coils *ab* and *ec*, as required.

Remarks.—Admitting the exterior diameter of the pipe to be 4·24 inches, it is evident that *three spires* of pipe may be introduced between each convolution. Consequently, the discharge of water would be four times as much as in the present case. But in order to ensure the discharge of a *maximum*, each convolution of the pipe ought to be in contact, as a large snail, 6 inches in diameter, will discharge more water than two smaller ones of 3 inches each. The angle formed by the coils, and the base of the cylinder, may in each case be considered the same.

Yours, &c.

J. UTTING.

Lynn Regis, June 1830.

STEAM-CARRIAGES.

Sir,—Seeing in your valuable miscellany that there is a person in Staffordshire in possession of a small steam-carriage, called "The Triumph (which I wish he would favour us with a description of), I beg to mention that there is a person in Hoxton, a working-mechanic, of the name of Lea, who has a small model that is worthy of the name of "Triumph." It seems capable of accomplishing every thing which a horse can do on any road or in any season, and it differs in its principle from every steam-travelling apparatus that has yet come before the public.

Yours, &c.

WILLIAM TURNER.

Old Hoxton, July 14, 1830.

SHALDERS'S PATENT GRAVITATING EXPRESSING-FOUNTAIN.

We have before given an account of this improved pump in our pages ("Mechanics' Magazine," vol. viii. p. 438), and are called upon to bring it again under the notice of our readers by a large packet of testimonials, which have been put into our hands, furnished to the patentee by parties who have had it or seen it in actual use, and all affirming its superior qualities in the most unqualified terms. There is, first, a certificate signed by thirteen persons, brewers, dyers, &c. in Norwich, Downham, Lynn, and other places, who have among them twenty-five of the expressing-fountains in use, and who say, "We find this extraordinary advantage in their performance—our work is done in half the time required with the best London pumps; and these machines are so remarkably simple, that they are easily repaired by our workmen at a trifling expense." Next, there is a letter from Mr. J. Newen, of London, who after two years' trial states, that Mr. Shalders's pumps have "caused him to relinquish pumping by his steam-engine." Then we have a certificate from Mr. James Broch, Master of the ship *Spring* of Yarmouth, who had an expressing-fountain fixed on board that vessel in June last, "since which it has been in much heavy weather;" and who certifies that it "constantly performed

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with more than double the effect of the common pump, and in no case became choked or otherwise deranged—always at commencing fetching the water with the greatest ease"—a statement confirmed by the testimony of Mr. C. W. Squire, a passenger on board the *Spring* from Dantzic to Leith. But still more to the purpose than any of these documents is the letter which we subjoin from an extensive coal-owner and engineer, who states at some length, and with great distinctness and clearness, the grounds of the preference which he awards to Mr. Shalders's pump.

Copy of a Letter from Mr. Thomas Hay, Civil Engineer, Proprietor of the Kidwelly Works, Carmarthenshire, and Collieries in Glamorganshire.

Sir,—I have been much pleased with the patent expressing pump—the construction of which is so simple, and its power at the same time so very effective, that I am surprised the idea of the invention has not long since occurred to some one, particularly to those concerned in mines, or any other pursuits where the lifting of water is necessary.

Some years ago I had the management of the sinking a shaft on a vein of coal through a great depth of sea sand, on low marshy ground, in Carmarthenshire, where with very great difficulty, we succeeded in sinking the shaft to the depth of 105 feet below the level of high-water mark; but in consequence of the great influx of water, and the quantity of sand forced up through the pumps, which were of the ordinary construction, and became frequently choked, we were obliged to abandon the works, which had cost the parties upwards of 10,000*l*. This was mainly, or entirely, attributable to the imperfect construction of the pumps, which being on the old or common plan, the box (or what you call the bucket) being in a truly bored cylinder, is made, of necessity, to fit the working barrel so tight that a considerable resistance presents itself to the moving power by the friction of the box against the sides of the working barrel, and the liability to the intervention of particles of sand or grit between the box and the cylinder necessarily causing the choking.

In one of my observations, at a depth exceeding 50 fathoms, driving principally through sand, stone, and rock, the shaft came suddenly into quick-sand, and at every stroke of the pump raised only sand and water; the former in the largest quantity, and until the box, in a 10-inch cylinder, was rendered useless. Had this invention then been known, it would have saved a great outlay and loss of money which then occurred.

In your pump all these difficulties are obviated, and I am quite sure if I had had your pump at work instead of those I have noticed in the above instances, as also many others, I should have succeeded to the utmost extent of my wishes in those undertakings. The box of your pump having no other connexion with the sides of the barrel than by means of the elastic leather, presents no friction; and I am fully confident were your pump filled full of sand, left in it even a sufficient time to get hard, there would even then not be the slightest difficulty in giving motion to the box; and *that* once effected, the sand, when mixed with water, acquires, as it were, a degree of fluidity, and your pump would be instantly cleared.

I do not think there can be a possibility of your pump choking: a circumstance too often attended, both on sea and land, with fatal consequences. I may say, there are three very palpable and decided advantages which this invention possesses.

1st. There being no leakage, the quantity of water raised at each stroke is considerably more.

2nd. As there is no friction, a great deal less of the moving power is requisite, and the durability of the machine is much better secured.

3rd. The utter impossibility of a pump, upon this principle, choking; all grit, sand, or whatever substance that can pass through the valves, being instantly thrown off and rejected in the action of what is termed the connecter.

And, I gather from these very important and striking advantages, that whenever the principle of the invention shall be applied, it cannot fail to act in the preservation of lives and property to an incalculable extent. Lives and property at sea—lives and property in mines.

I am firmly of opinion, that on your pump being introduced into the mining districts of Wales, its application will, in a very short time, become general there, (and why not every where else?) from the very obvious and great advantages the use of it

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must possess over the common pump.

Yours, &c. THOMAS HAY.

Kidwelly Works, August 24, 1829.

The only other testimonials which remain to be noticed refer to certain trials which were made of Mr. Shalders's pump on board his Majesty's ship Monmouth, during the severe weather in the month of December last. It may suffice to quote one of the most remarkable. Mr. J. R. Hill, civil-engineer, states, that they found "the action of the fountain-pump impeded by a great quantity of ice; but, having the assistance of two powerful men, they actually raised up a considerable quantity of ice, many lumps of which were taken out by hand equal in size to the diameter of the working barrel, and until but little water remained in the ship's well." And this while the other pumps of the ship on the common plan, as also those of the Blenheim 74 lying alongside, were at the time, more or less, all frozen up and useless.

Supplementary Observations by the Patentee.

As the fountain produces a most decided and incontestably superior effect compared with the pump, allow me, ye men of science, to go into both machines whilst they are in action, and inquire what goes on with each internally? The following advantages possessed by the fountain will be apparent. It is more simple, less expensive, more elegant in action, less liable to choking, and more efficient in the proportion of five to three. *More simple.*—Let reciprocation be considered as unity in both machines—the fountain has but one action and one effect—the expresser and connecter gravitating by their own weight, receive the supply of fluid, and assist in raising the lever; when they are raised again the fluid is expressed to the delivery with a pleasant natural rolling motion, having only the weight of the fluid to overcome, forming a perfect railway for raising water, which can never be surpassed. The pump has three actions to produce one effect; the piston is forced down to receive the supply of fluid; the cupped leather, which is the best kind of spring piston, partly separates from the cylinder to slide down with less friction, and, when raised again, the cupped leather slaps against the cylinder, whilst the weight of the water steps from off the lower valve into the piston, the leather forming a circular line, which scrapes off the water with some leakage, and an enormous friction; the piston acting in the very teeth of the natural law of fluids, wasting eleven out of twenty-six of the whole power used. *Less expensive.* — The fountain requires no truly bored cylinder, the working parts performing altogether as well in wood coopered together, as in the finest metal; the only hydraulic parts liable to wear out are the connecter and valve leathers. The connecter never exceeds five shillings, except below and larger than number eight; which delivers 20lbs. or two imperial gallons per stroke. One example will show a first cost comparison. An excellent oak-built fountain, with metallic valves and expresser, delivering 20lbs. per stroke, now stands upon premises in Norwich, by the side of two new elm pumps, from an eminent maker in London, that deliver from 10 to 12lbs. each pump per stroke. One man at the fountain keeps two men at the pumps fully employed to raise the like quantity of liquor to the same height; the two pumps cost nine pounds, and the one fountain 6*l.* 10*s.*, saving more than forty per cent. in outlay, and one hundred per cent. in labour. And the fountain will be sound when the pumps are rotten. *More elegant in action.*—The instant the power is applied at the fountain, the expresser and connecter take hold of the fluid, which moves with so light a breath, that the inertia of water is imperceptible even when moved by weights with an accurate balance. But the instant the piston of a pump takes hold of the fluid, its packing is forced to the cylinder, and the main friction begins; and, to overcome the inertia of friction, causes a twitching in the face and limbs of the operator, at commencing each stroke of a short effective pump, most apparent with a light lever: this distresses men more than is imagined when working for a long time. *Less liable to choking.*—The parts of the fountain working more than an inch

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from one another—small stones, bullets, shots, splinters, peas, pepper, wheat, or other grain, gravel, or a few pecks of sand, being put into the fountain are soon discharged full to the bottom, or remain harmlessly upon the works until convenient to clear the same; but the parts of the pump squeeze and scrape so together that, when putting only a handfull of sand into an excllent pump, I was under the necessity of drawing the piston to prevent the packing, grinding to pieces. *More efficient.*—Friction, adhesion, inertia, and leakage—the insurmountable objections to the pump are all avoided by the fountain, and the whole of the power used remains so entirely unencumbered that the weight of the water raised equals the power consumed, and reduces the raising of water to a science.

Now, Drs. Robinson and Brewster, the only pump question that you rightly considered to be of any interest is settled. The performance of an untried hydraulic machine is no longer a matter of practical conjecture, but of calculation. If you maintain that the maintaining power of a man is only equal to the raising 5,000lbs. weight, through one foot per minute for seven or eight hours in succession, I will produce machines that shall raise 500lbs. of water through ten feet, 200lbs. through twenty-five feet, or 100lbs. through fifty feet per minute with that power, which is the same thing. Doctor Hutton justly says, that man is ignorant of mechanics who expects to raise more water with such a power. But I have seen a young man weighing 130lbs. make 50 twelve-pound strokes, raising the water 25 feet high in one minute with the fountain, 600lbs. or 60 imperial gallons, which is three times the aforesaid quantity, being 15,000lbs. through one foot, or equal thereto. I have also instituted numerous trials, to various heights, by many men, with divers pumps, but could never find a pump with which the power of one man could raise a quantity of water more than equal to about 8,000lbs. through one foot in one minute; and what I consider conclusive, I have made many experiments with weights and an accurate balance, raising both the expression of the fountain and the piston of the pump, but could never discover any loss of power with the fountain, but the friction of the pump reduced the effective power from 26 to 15. I therefore claim a balance in favour of the fountain of 73 per cent. Such an extraordinary advantage obtained cannot fail to begin a new era in the art of raising fluids. For who that wants dispatch in business would go or send five miles round about, when a better road lies directly before him, more than two miles shorter? And this must be the case with all who use pumps, now fountains are attainable; which instantly demonstrates that eminent men have been labouring at an impossibility—boring, grinding, polishing, and packing, for two thousand years, to make a good machine upon a bad principle. What dangerous guides are superficial men! My opponents, after vainly endeavouring for years to prove there is nothing new under the sun, are now compelled to acknowledge that Mr. Benjamin Martin's hydraulic machine is the one most like mine; but his pump is as much inferior to my fountain in its construction, as my opponents are inferior to Sir Isaac Newton in intellect: and the action of the water in the two machines differs as widely as the walking upon firm ground, and being tossed in a blanket. But had Martin used a cone instead of a cylinder, it would have prevented his leather from swinging outwards. If Martin had been able, and had blocked his leather, he might have obtained a dip sufficient; and, above all, had Martin used an expresser instead of a brass ring, his leather could not have swung inwards with the pressure of the water, and would also have prevented the flapping motion in the returning stroke, upon which entirely depends a pleasant action. These are, each and all, indispensably essential; but Martin has no cone, no expresser, and only the worst half of a connecter. I wish wholly to avoid every thing invidious towards the ingenious Mr. Benjamin Martin. But as his pump is brought forward to oppose the introduction of my fountain, upon which hang the lives of millions, I must say had that gentleman possessed five shillings worth

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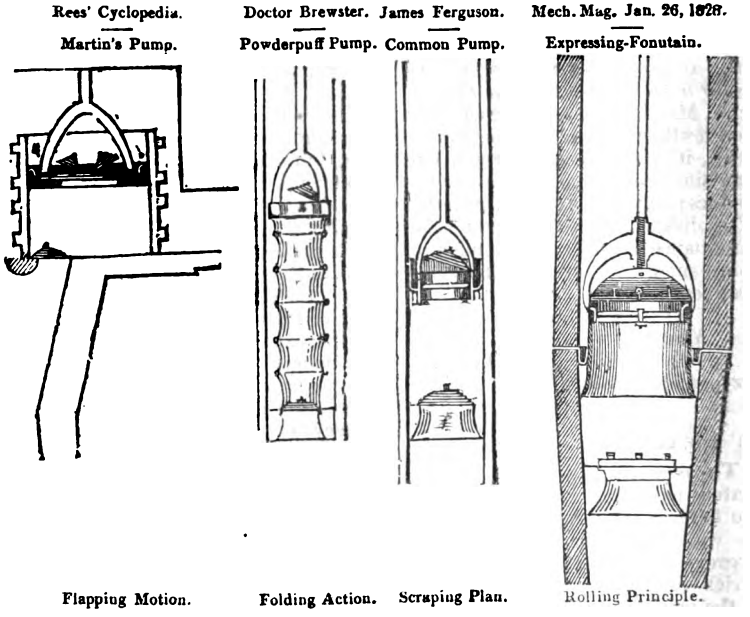
of hydraulic knowledge (a quantity too large to expect from the whole of my opponents), he would not have proportioned the parts of his abortion so preposterously. There are a great many more bad points in the same machine, any one of which would suffice to destroy a large portion of the effect and durability; and the whole of that beautiful soft action for which the fountain is so much admired. But the fact is this—The jolting, distressing, half-effective action, called shortness of stroke, was the downfall of Mr. Benjamin Martin's pump. The second objection to that machine, respecting the works drying when not used, falls to the ground; since a pump holds water, if not used for months, when the valves are good.

The better to show the superior construction of the fountain, I here give sections of it, and of the three pumps most commonly opposed to it, placed side by side.



The working parts in the section of the four machines are supposed to be descending with their upper valves open, receiving their supply of fluid, and showing how the upward pressure of water influences the action of the leather in each machine.

W. SHALDERS.

P. S.—One connecter in an engine-fountain has raised the water from a well 97 feet deep for 20 months, for the purpose of building four large houses, and now shows no signs of decay, and in all probability will last many years: whilst pumps on the old plan in the same neighbourhood, that have not raised so much water, have been releathered more than once. The fountain may be seen in action at the National Repository, Charing-cross, London.

W. S.

REMARKS ON THE SOLUTIONS OF SIR ISAAC NEWTON'S ARITHMETICAL QUESTION.

Sir,—Mr. Samuel Latham has changed Sir Isaac Newton's enunciation to this question for the following reason, which he states at the commencement of his algebraical solution:—"It will be found by inspecting Sir Isaac Newton's algebraical

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analysis of this question, that he supposes the grass not to grow at all during the first 4 weeks in either of the meadows," &c. (see p. 340, vol. xiii.)

Now, Mr. Editor, I beg leave to state that, in my humble opinion, Mr. Latham is mistaken in this supposition, for on examining Sir Isaac Newton's solutions, I can find nothing that would seem to warrant such an hypothesis. G. S. in both his arithmetical and algebraical solutions, seems to be of a different opinion from that of Mr. Latham, or, if otherwise, what could he mean by stating in the ninth line of his general solution, "Therefore, if *a*P*c* represent the quantity of grass at first on the meadow *b*P, *together with the growth for the time c*," &c. Mr. Latham states, there was no growth at all during the time *c*. Well, it appears that mathematicians sometimes differ in opinion as well as divines; but as the subject is rather of a difficult nature, it might be of importance to have the opinion of some more of your scientific correspondents.

I am, Sir,
Your very obedient servant,
N. LOGAN.

Oxford-street, July 26, 1830.

ON THE DEW POINT. BY A. A. HAYES.

To assist those who are not intimately acquainted with hygrometry, the following illustrations of the facts, on which the experiments with the hygrometer are based—with the tables, which for convenience are attached to the scale of the instrument I use—are offered, with the hope that they may induce many to make observations with that instrument.

When a smooth surface of any substance which possesses no attraction for water is exposed to an atmosphere in contact with water, if the temperature of the surface is considerably below that of the atmosphere, it soon becomes covered with moisture, which increases and assumes the form of dew. By observing the temperature of this surface, we learn at what temperature the invisible vapour previously existing in the atmosphere, becomes tangible in the form of water; the temperature may be considered as the "point of deposition," and it bears no permanent relation to the temperature of the vapour. Aqueous vapour, while forming, is of the same temperature as the surface of the fluid from which it is produced; and if, after this experiment we allow the surface of the substance gradually to approach the temperature of the atmosphere, the moisture begins to disappear and the thermometer remains stationary, while any considerable portion of moisture is on the surface. The temperature now indicated by the thermometer is that of the vapour, and for convenience is called the "dew point." It is evident that the point of deposition bears the same relation to the dew point, as the "freezing point" of water does to the "fusing point" of ice; it may be below, but can never be above it. By confounding these terms, some writers have caused considerable ambiguity; and we are inclined to place little confidence in the results of these experiments, when we are informed that "the comparison of the temperature of the air, at the commencement of the experiment, with the mean of the indications of the thermometer, at the appearance and evanescence of the dew, will give with relative accuracy the measure of the force of vapour in the atmosphere." The dew point, ascertained by the aid of suitable instruments, enables us to solve several important problems, which could not be done when hydroscopes of animal and vegetable substances were employed; as these, besides being subject to many imperfections, indicate a state of "dryness" when the atmosphere is nearly saturated with moisture.

I. Having ascertained the dew point, on referring to a table of the elasticity of steam, we learn the *tension* of the atmospheric vapour, expressed in inches and parts of the mercurial column.

II. By dividing the numbers denoting the elasticity, by that of the mean barometric height, we ascertain the *volume* of vapour in one hundred cubic inches of the air surrounding the instrument.

III. Multiplying this number, by the weight of one hundred cubic

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inches of steam, the *weight* of vapour in one hundred cubic inches is found.

IV. Dividing the mean barometric height, by the numbers denoting the elasticity, the proportion of pressure due to the vapour is determined.

V. The numbers denoting the elasticity, multiplied by the specific gravity of mercury; the numbers obtained on the inches, and parts in depth of water, which would result from a total condensation of the whole vapour. Other interesting results are readily obtained from these numbers.

The following table exhibits the results, without the delay of arithmetical processes; the numbers expressing the elasticity of steam, are from the table by Mr. Dalton; his numbers being a mean between those of Mr. Daniel and Dr. Ure :—

Dew Point	Elasticity.	Volume.	Weight.	Water	Dew Point.	Elasticity.	Volume.	Weight.	Water
+ 1	·066	·22	·42	·894	49	·363	1·21	2·30	4·91
5	·076	·25	·47	1·03	50	·375	1·25	2·38	5·08
10	·090	·30	·57	1·21	51	·388	1·29	2·45	5·25
15	·108	·36	·68	1·46	52	·401	1·33	2·53	5·43
20	·129	·43	·81	1·74	53	·415	1·38	2·61	5·61
25	·156	·52	·99	2·11	54	·429	1·43	2·72	5·79
30	·186	·62	1·18	2·42	55	·443	1·47	2·80	6·00
35	·221	·74	1 41	2·99	56	·458	1·52	2·89	6·20
36	·229	·76	1·44	3·10	57	·474	1·58	3·00	6·41
37	·237	·79	1·51	3·21	58	·490	1·63	3·10	6·63
38	·245	·82	1·56	3·32	59	·507	1·69	3·21	6·85
39	·254	·85	1·61	3·44	60	·524	1·75	3·33	7·10
40	·263	·88	1·67	3·56	61	·542	1·80	3·44	7·34
41	·273	·91	1·73	3·69	62	·560	1·87	3·56	7·58
42	·283	·94	1·79	3·83	63	·578	1·92	3·67	7·83
43	·294	·98	1·86	3·98	64	·597	1·99	3·79	8 08
44	·305	1·02	1·94	4·13	65	·616	2·05	3·90	8·35
45	·316	1·05	2·01	4·28	66	·635	2·11	4·02	8·60
46	·328	1·09	2·07	4·44	67	·655	2·18	4·15	8·88
47	·339	1·13	2·15	4·59	68	·676	2·25	4·28	9·16
48	·351	1·17	2·23	4·75	69	·698	2·32	4·42	9·47
					70	·721	2·40	4·57	9·77

American Journal of Science and Arts.

REMARKS ON MR. JENKINS'S PLAN FOR THE PROTECTION OF HOUSES FROM FIRE.

Sir,—I cannot refrain from offering a few remarks on the method of extinguishing fires in houses, proposed by Mr. C. E. Jenkins, and described by your correspondent, "Pit," in your 362nd Number, p. 325.

In the first place, I shall show that something of a similar description was proposed some years back.

In August, 1807, Dr. John Carey, of Islington, obtained a patent for his invention of various contrivances for preventing or checking fires, &c. &c.; a detailed account of which is given in the "Repertory of Arts," &c. vol. x. Second Series, page 407. Among others was the following method of effecting this purpose:—

Upon the top of the house was to be placed a cistern filled with water, either by collecting rain, or by means of a pump from below. From this cistern a metal pipe proceeded to the lower part of the building, opening into each room near the ceiling, and furnished with a cock, terminating in a perforated rose. Each cock had a bar or lever by way of handle, sufficiently heavy to open the cock when left to obey the laws of gravitation. The bar was retained in a *horizontal* position, and the cock consequently closed by means of a small cord, which passed round the room through rings, to the last of which it was fastened.

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Things being in this situation, if a fire occurred, it was expected the cord would burn with the other combustibles: the consequence of which would be, the fall of the lever, opening of the cock, and the entrance of the water, in the form of a splendid shower-bath, sufficiently powerful to exterminate the fiery intruder.

The patentee's proposal was, to have one or more of these cocks in each room, in proportion to its magnitude, or to use a metal pan nearly as large as the ceiling, perforated on the under side, which would distribute the water more completely over the apartment. The patentee farther observes, "instead of a rose, the cock may be furnished with a hose or tube of leather, or other fit substance, with a nozzle at the end, so that a person may direct the stream of water where he pleases; and in this case, the cock, hose, and nozzle, may be concealed in a closet." This last arrangement corresponds exactly with that which I recommended at page 384 of your eighth volume.

A perusal of the above will show that the contrivance now brought forward is not quite so new as Mr. Jenkins and his friends may have imagined; the only part that is really new, is the employment of a fire-engine to throw the water into the building—which I do not hesitate to say, is the most injudicious part of the whole arrangement.

Your correspondent, "Pit," has stated several objections to this plan; but there are others of equal importance with those which he has mentioned, which render its utility something more than *doubtful*.

In the first place, the expense of fitting up a moderate-sized house *would exceed* 20*l*. And secondly, supposing a house so fitted, the chance is, that in the event of a fire, several engines might be brought before one could be found, whose hose-screws would connect with the screwed tube of the apparatus. Again, there is the risk of the engine being out of order; besides the delay in getting it to work, to say nothing of the uncertainty of obtaining a supply of water.

Who, therefore, will incur the expense attending the adoption of this apparatus, when the chances of its never being required, or of its not being available if required, are so very great? If any portion of the plan is worth attention, it is that part of Dr. Carey's patent, which I have before recommended.

For my own part, I would say, instead of each householder incurring an *enormous expense* for an apparatus of doubtful utility, let them each subscribe *a trifle* to keep their fire-engine in good repair; and place it, with a proper remuneration, in the hands of a person qualified to keep it so, and to make good use of it when necessary.

I am well aware that there is much truth in the remarks of Mr. Jenkins on the waste of water, which generally occurs at London fires. Though I believe it is generally attributable, not to the firemen, but to persons having charge of parochial and other engines.

At a fire in the City a short time since, at which I was present, the roof and attics of a large house were burning with great fury, a parish engine was worked, and briskly worked too, for nearly three quarters of an hour; during which time it never threw a drop of water into the building. The house being a high one, the fire was out of the reach of the jets of any but the largest engines: and there stood the person with the branch of the above engine washing the front wall of the house—endeavouring, but vainly endeavouring, to deliver some portion of water into the fourth floor window. Had this man done as the firemen did, even with their more powerful engines, and as I early advised him to do—that is, had he carried his hose either up into the house where the fire was raging, or on to the tops of those adjoining, the labour of eight men and about 3,000 gallons of water might have been turned to good account instead of being, as I saw them, *both wasted!*

I have before endeavoured to impress upon your readers the necessity of combating fires at *close quarters*;* and I now add, that to stand on the

* See vol. x. page 310.

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outside of a house with the branch of a fire-engine, so long as the *interior* can be *advantageously* and *safely* entered, exhibits a decided want of skill and courage, and is the principal, if not the sole cause of the waste of water which Mr. Jenkins so justly censures.

Yours, &c.
W. BADDELEY, Jun.

July 20, 1830.

THE CAMERA LUCIDA.

Mr. Editor,—A good deal has been said about the camera lucida in your Magazine, and through the kindness of a friend, whose instrument I borrowed, I am enabled to say, the praises bestowed upon it have not been overrated. Nothing, however, has been said in your pages about the price; one of your correspondents recommends the instrument as *made** by Dollond, whose prices are from 31*s.* 6*d.* to *seven guineas!* A guinea and a half for a brass clamp, a piece of drawn tube, and a glass prism stuck on the end of it, is by far too much for a cabinet-maker or other mechanic (to whom the instrument may be really useful) to spare. I am sorry to perceive your correspondent, H. J., who seems so well acquainted with the subject, has declined farther correspondence on the camera; I can only in conclusion remark, that any lapidary will cut a glass prism to pattern, and the brass-work (to answer practical purposes) may be finished by any ordinary workman, making the expense less than one-third the price of the commonest instrument.

I am, Sir,
Yours, &c.
J. E.

July 26, 1830.

THE IMPROVEMENT OF THE LUNE.

Sir,—I was much interested in the letter of your correspondent, M. Saul, in the "Mechanics' Magazine" of this month relating to the navigation of the Lune, which, from the remarks I have made, I have little doubt might be equal to that of some of our best rivers.

My opinion, however, is, that no effort to cut and keep open a direct channel would succeed without the employment of other means, because owing to the breadth of sand, especially in dry seasons, there would not be a sufficient force of fresh water (even with the assistance of the proposed steam-engine), to throw out the vast quantity of sand brought in by the tide.

Those who have navigated the Lune will perceive the tide and fresh water act in different directions; the latter would be inclined to maintain a straight line from north to south, something like Mr. Saul's proposed line marked A in the chart—the former, however, sets in from the west, and proceeds along the eastern side till it is impeded by a gravel-bed a little below what is called Aldcliffe Bite. Against this gravel-bed it strikes with considerable force, and thence rebounds to the opposite side, forming an angle very awkward to navigate. Nothing, in my opinion, could prevent this but the formation of a jetty or breakwater of loose stones, which should be thrown out directly west, and in consequence of which the tide would proceed in a direct line to A at the north end of Mr. Saul's line, and thus the most awkward part of the navigation would be saved. These jetties, which are of little expense in the workmanship, have done much in the Clyde, where vessels of 300 tons now easily navigate, and which before the introduction of jetties would not admit craft of more than 30 tons. The channel of Ribble is undergoing considerable improvement by the same means; and there is no doubt if the channel of Lune could be confined to a narrower space, vessels of large tonnage would be brought without difficulty to the quay at Lancaster.

I am, Sir,
Your obedient servant,
NAVIGATOR.

Lancaster, July 19, 1830.

* From good authority I learn they are all chiefly *made* by an o[illegible] surveyman in the neighbourhood of W[illegible]

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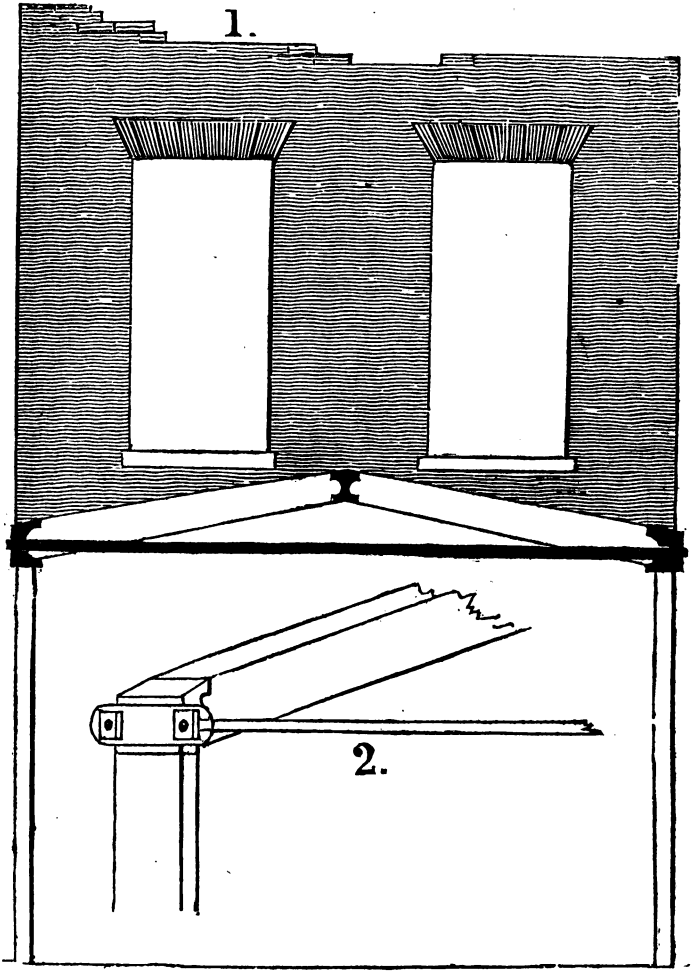
A NEW BRESTSUMMER.



Sir, — As I was passing along Bishopsgate-street this day, I stopped to observe some new houses which are building there (opposite to the Vine Inn), when I noticed that two of them were not built exactly in the usual way, being supported in a somewhat novel mode, as the brestsummers are of entirely modern construction. I herewith enclose a sketch of one of them, and request the criticisms of your scientific correspondents on the invention.

The two story-posts and the timber used in the brestsummer are of about the usual dimensions, and the iron-rod is *two* inches in diameter. The weight to be upheld is unusually great, as the house is four stories high above the ground. Who has the honour of designing such an unique model for stability I know not, but I pity the injudicious credulity and rashness of the builder who ventures to endanger the lives of his Majesty's subjects, and particularly the life of

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his employer by the adoption of such a brestsummer. The object of it is to avoid the use of story-posts or iron-columns, which obstruct the light, and are somewhat inconvenient.

After a slight inspection of the drawings, the least scientific of your readers (of which class I am one) will be enabled to perceive the absolute impossibility of such an erection either enduring long or standing with certainty, as the main weight and thrust acts upon the thread or worm of the screws at the ends of the iron-bar, and should they fail, which is very likely indeed, then the centre of the front must sink, and the greater part of the house fall into the streets. The adjoining house being a corner-house, supported on three sides by posts, affords no support to the abutment at one end. I could with ease have given a drawing of the common truss, which would have been sure to stand, as it has been frequently proved; but as there was in this instance no necessity whatever for such a thing, it would be useless, for as they must have door-posts, iron story-posts or columns might without any superfluity of ingenuity have been introduced behind them, and without at all diminishing the quantity of light.

A building resting on such a prop may stand some length of time, but it is not sure, nor ought to be relied on, for the reasons before assigned.

I am, Sir,
Yours respectfully,
VULCAN.

P. S.—I should esteem it a great favour if any of your correspondents exhibit to your readers the safest and most economical roof principle for churches where the span is great, say from 70 to 80 feet.

FRANKS' PERPETUAL LEVER.

Sir,—I send you a description of my new "Perpetual Lever," or "Improved Principle of Gearing," which I will be glad to see inserted in the "Mechanics' Magazine."

Yours, &c.
WM. FRANKS.

16, *Cursitor-street, Chancery-lane,*
July 3, 1830.

My invention consists of a new plan of Gearing, applicable to general purposes, where a rotary motion is wanted to be produced by wheels and pinions, for producing a slow motion, with a surprising increase of power or rapidity of action, which I can obtain by my invention with a less quantity of wheels and pinions, and more strength in the arbor and teeth, and less friction, than can be obtained by the common method of constructing wheel-work. One of the principal advantages I obtain by my improvement in Gearing is the simple form: I introduce the pinion into machinery (for I am able to apply my power nearly into the centre of the arbor of the pinion), when it is wanted to gain great power or velocity, which is impossible by the common method; consequently I can make it exert twice the power that can be obtained by any other machine of Gearing, or gain astonishing velocity. For instance, I can make a wheel only three inches and a half in diameter give thirty revolutions to the pinion which it has to drive, and with the same mechanical power as would require a wheel nine inches in diameter, of two hundred and forty teeth, with a pinion of eight leaves or teeth; consequently a great economy in constructing machinery, and a saving of one-half in power in its general use. A watch, which is the smallest machine I am acquainted with, could be made, after my method, to go six weeks; and, in the same small compass as is now required for it, to go two days; and a common clock that now goes eight days can, after my plan, be made to go twelve months, with no more wheels, only difference in construction. In fact, I have no hesitation in saying I could make a clock to go from ten to twenty years, or even much longer, and strike every hour during that length of time, with only once winding up. My invention is equally applicable to large machinery as small; for in many machines which would require a steam-engine or water-wheel of twenty-horse power to work them, I can, by my method, bring about the same effect by an engine of much less power, in consequence of the few wheels I employ, and the great re-

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duction in friction, whereby I can gain more power than is to be obtained by any other method of Gearing, and requiring much less expense in working it when constructed. It can likewise be applied with extraordinary use and advantage to a crane or engine for raising immense weights, or to a press for obtaining great pressure; for one man will be able, by my improvement, to work a crane with the same ease as two men would find now. In fact, so simple is its construction, with the surprising power I gain, that a child might raise a weight of many tons, and with so diminutive a crane or engine that it would stand in the space of six inches; or a man could raise a ship out of the water, and examine its bottom with the greatest ease, by my invention. It could also be applied with particular advantage to the capstan of ships. Indeed, if universally known, it would doubtless be applied to almost every species of machinery.

A working model is made, and now in action.

Enquiries.

Paddle-Wheels.—Sir, Can any of your readers inform me whether the paddle-wheels, for which Mr. Oldman, of Dublin, took out a patent some years ago, and which were spoken of so favourably by Mr. Charles Williams in his evidence before the Committee of the House of Commons in 1822, have been adopted, and if so, whether they are continued to be used by any vessel—if not, whether a model of them can be seen in London? Also the nature of the paddle-wheel of Mr. Morgan, tried on board the *Confiance* last month on the river, of which the newspapers spoke so highly.

NAUTICUS.

London, May 30, 1830.

[Mr. Oldham's paddle-wheels are described in Dr. Lardner's Lectures on the Steam-engine, page 161. They are on the feathering principle. Dr. Lardner observes, "I have instituted experiments with this wheel, compared with the common wheel, and find the results coincide most satisfactorily with those wheels I have deduced from mathematical calculation." We shall give a description of Mr. Morgan's wheel in an early Number; but we have reason to believe that its efficiency has been greatly overrated. —EDIT.]

Horn-Handles.—Sir, Having noticed the beautiful manner in which the handles of umbrellas and parasols are now executed in horn (which it is evident are cast in dies as the joint is frequently visible), and not being able in my confined circle or limited library of reference to gain any information, I take the liberty of troubling you, hoping that the intelligent readers of your valuable Miscellany will give the wished for information. By what means is horn dissolved? Is any preparation applied before dissolving? Is any thing mixed with it when dissolved? What are the best means of preventing its shrinking or twisting while drying? In what state is it put into the die? Answers to these questions, or any other information from those better informed than myself, will infer an obligation on,

Sir,

Yours, &c.

A. P. A SUBSCRIBER.

June 9, 1830.

[The above supersedes a similar enquiry by J. W.]

Fire-Engine Pipes.—Sir, Permit me, through the medium of your valuable miscellaneous publication, to inquire of your numerous correspondents the best method of making suction or feeding pipes (if I may be allowed to use the term *suction* in the present age of refinement) for fire-engines. The engines, for which new pipes are wanted, were made by S. Phillips, near Blackfriars' Bridge, London; and the old pipes belonging to them are formed of a number of tin cylinders, each about 2 inches long, and the diameter is according to the size of the engine. These tin cylinders are successively laid at the end of each other—the whole forming a pipe. They are then covered with linen, and afterwards with leather. To a pipe of the above description there are three objections. 1st. It is not sufficiently elastic. 2nd. It is very easily crushed. 3rd. It does not long remain air-tight. It may be asked, after once being air-tight, why does it not continue so? While the leather is new and supple, the seam will be good, but after having been several times alternately

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wet and dry, the seam will give way; consequently air will rush in, and the engine will but receive a very inadequate supply of water, if entirely depending on such a source when in use. The first and second of the above objections may be obviated by substituting a coil of iron, or other wire of a suitable thickness, instead of tin-cylinders. But the third, which is the principal objection, would of course remain the same. Should any of your correspondents be in possession of a better method, and will communicate it to your Magazine, he will confer a favour on,

Sir,
Yours, &c.
F. Moore.

Wentworth, June 10, 1830.

Cavallo on Æronautics.—There is a work, written by Cavallo, entirely upon æronautics, but it being out of print, I cannot get it at my booksellers. Some of your correspondents can perhaps inform me, through the medium of your useful Magazine, where I can purchase it, or another upon the same subject, by Baldwin.

I am, Sir,
Yours, &c.
R. C.

Spalding, June 18, 1830.

Rotary Steam-Engines.—What are the powers of a rotary steam-engine compared with those of a reciprocating one of the same cubical capacity, taking into consideration, first, the uninterrupted action of the power in the former; secondly, the increased length of lever; and, thirdly, the increasing velocity or momentum? For instance—what would be the difference between a rotary of 9 feet circumference, 3 inches diameter in the rim or cylinder, and a cylinder of the same diameter, 18 inches stroke, supposing the latter to make 6 strokes for one revolution of the former; and farther, supposing that the piston of the cylinder communicates its power to a 3 feet diameter wheel by a crank of 6 inches. The friction of the pistons to be alike in both machines.

C.

Wheel-work. — 1. Suppose a first moving wheel 2 feet diameter, with a power equal to 5lbs. to turn it—Is it possible in any way to make this power sufficient to work another wheel 2 feet 5 inches in diameter, with a pressure of about 1½lb. on the rising side, at 4 times the speed of the moving wheel? If not, how much power will be required upon the first moving wheel to turn the other, with the above pressure and speed?

2. Would any power be gained by making the first moving wheel considerably heavier than the other, or *vice versa?*

3. The speed is gained by two pair of 2 and 1 cog-wheels reversed; how should they be proportioned in size to the first mover, according to the above diameter, so as to exhaust the least power?

Information from the intelligent and more experienced is doubly valuable when the inquirer is in want of means to make the necessary experiments to arrive at demonstration.

I am, Sir,
Yours, &c.
Juvenis.

Bromsgrove.

LARGE ARCHES.

Sir,—Your engraver has made an unfortunate omission in the scale under the drawing of Chester Bridge in your last Number; he has left out my explanation, which was this:—

A. New London Bridge, centre-arch.

B. Brioude Bridge.

C. Chester Bridge (unfinished).

Without this, the diagram is unintelligible, and nobody but Mr. Davy would find out that the three curves exhibited the contour of the three arches above-mentioned.

Yours with respect,
A Lover of Large Arches.

July 24, 1830.

INTERIM NOTICES.

Part Second of the "Spirit of Literature," price 1*s.* is just published. Also Part XC. of the "Mechanics' Magazine," price 1*s.*

Communications received from A Sailor—Alpha—Mr. Greig—Y. H.—Medicus—Luat—N. S.—W. Primeall.

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Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 365.] SATURDAY, AUGUST 7, 1830. [Price 6d.

JEFFRIES AND HALLEY'S IMPROVED BLOWING-MACHINE.

Fig. 1.

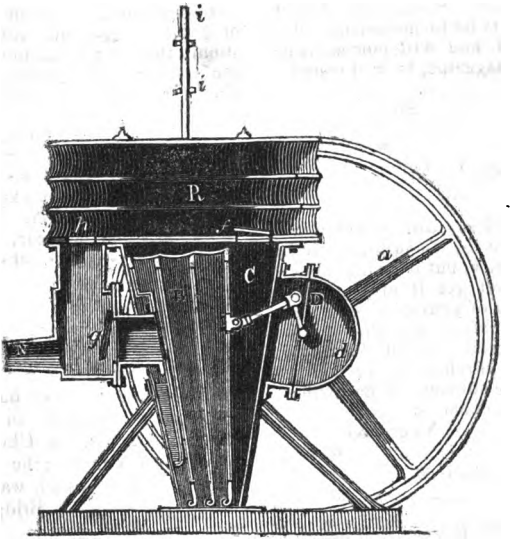
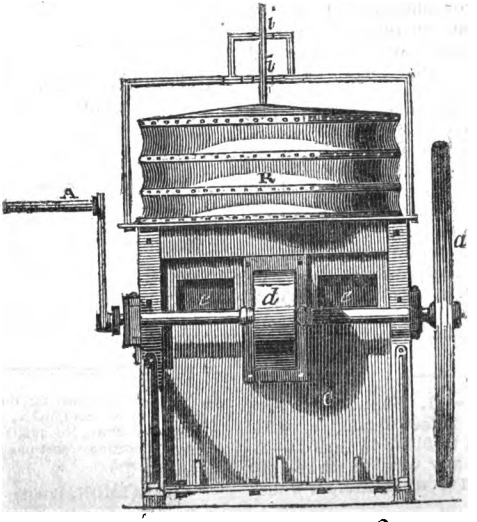


Fig. 2.



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JEFFRIES AND HALLEY'S IMPROVED BLOWING-MACHINE.

Sir,—The various methods of increasing the effects of combustion by means of blasts having lately attracted much attention, I am induced to send you a description of Messrs. Jeffries and Halley's improved blowing-machine.

This highly ingenious and useful apparatus is constructed on a principle somewhat analogous to the pump of M. De la Hire, described at page 281; inasmuch as it is *double-acting*. Fig. 1 is a side section, and fig. 2, a hind view of the machine.

A is a handle by which the machine is worked, having a large fly-wheel at the other end of the axis for equalizing the motion.

B, the bellows, situated vertically in an air-tight box or case C.

D, a crank fixed on the middle of the axis, and revolving in an air-tight semicircular box *d*. By means of this crank the rotary motion, impressed at the handle, is converted into a reciprocating one, for the purpose of alternately opening and shutting the bellows B; which, being placed vertically, require only a small degree of power to keep them in action.

The box, or outer case, C, in which the bellows are enclosed, being air-tight, it necessarily follows that when, by the action of the crank D, the bellows are compressed, a partial vacuum will be formed in the case C. In order to restore the equilibrium thus destroyed, a portion of external air will rush in through the two valves *e e*, fig. 2; which portion will, by the next succeeding expansion of the bellows, be driven through the valve *f* into the regulator R, which it inflates and raises, and from which it is driven through the aperture *h* to the nozzle N.

At the same time the expansion of the bellows will form a partial vacuum within them, to fill up which the air will rush in through two valves in front of the machine, situated one on each side of the nozzle N, and directly opposite to those *e e*, fig. 2. On the next compression of the bellows, the air contained in them is forced through the valve *g* into the nozzle communicating with the regulator R by the opening *h*.

The top of the regulator may be loaded with weights, in order to give any required degree of compression to the enclosed air, and the regulator is preserved in a vertical position by a rod passing through guides *i i*. The whole of the apparatus is of iron, except the leathers of the bellows and the regulator.

This apparatus is well adapted for large smitheries, foundries, and all places where a strong and continuous blast is required; it has met with the approval of the most distinguished artificers, in the dock-yards, and elsewhere; and Messrs. Halley and Jeffries received *the large silver medal and fifty guineas* from the Society of Arts* for their invention.

The principle of this machine might, I think, be advantageously applied in the erection of large wind instruments, as organs, &c. A small model, also, would make an excellent blow-pipe.

Any of your readers, passing Upper Ground-street, may see one of these machines in daily use at Messrs. Ward and Ainger's extensive iron-foundry.

I am, Sir,
Yours, &c.
W. Baddeley, Jun.

ANCIENT AND MODERN WORKS OF ART.

Sir,—There is in society a set of people mostly belonging to what is called the old school, the number of whom, however, is fast diminishing, who are always lamenting the degeneracy of the present age, and dinning our ears *ad nauseam* with "the wisdom of our forefathers," which seems to be their watchword. These are generally distinguished by an equal ignorance of, and contempt for, the improvements of the existing æra, insomuch that some of them are not content with asserting our woful deterioration in character (which it is not our business to refute), but if one ventures to hold that the power of mind over matter has been greatly in-

* A very full description of the machine is given in the 38th volume of the Society's Transactions.

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creased above what it was in the most renowned periods of antiquity, they immediately ease themselves of a vast deal of contempt for all modern works, and then we have an eulogium *con amore* on the gigantic labours of antiquity, as the pyramids, the Roman aqueducts and amphitheatres, &c. To discuss this question fully is not the intention of this communication: but for the edification of the above sect, let us endeavour to draw a comparison between a celebrated work of antiquity, one of their favourite themes, and one of the most remarkable of modern labours:—

PYRAMID OF CHEOPS.	NEW LONDON BRIDGE.
Built by	
A king, with the lives and property of a large nation at his command, the main strength of which was exerted to build it.	A body of merchants, with some assistance from Government, not interfering with other works, going on at the same time.
At the Expense of,	
According to Herodotus and Diodorus, 360,000 men for 20 years: all torn from their families, and driven like slaves to the work; and, no doubt, a vast number killed in the job, as is the fashion in Egypt.*	Say 1000 men for 5 years; all glad to come; well paid and well treated, those who met with accidents being provided for.
Difficulties of Construction.	
Half constructed by nature, the great pyramid being a natural rock cased in an angular building—the foundation, of course, ready made.	Nothing done by nature, the foundation being the soft bed of a river, requiring deep digging under water, and many thousands of piles driven to get a firm footing.
Shape, the easiest possible to construct in every respect, being nearly that which a heap of stones would assume if thrown carelessly one over another. The interior consisting of long narrow passages running up and down, seldom admitting a man to walk upright, wells and other inconvenient contrivances, and 3 or 4 narrow chambers,† none of which present any thing remarkable, except that they are lined with granite, well joined and polished,‡ and that the roof of one chamber is formed of flat stones 18 feet long and 4 broad, which must weigh 10 tons. The largest chamber, 66 feet long by 27 broad, is excavated in the live rock.	Shape, the most difficult ever built, the flattest, largest,§ and heaviest stone arches in the world; 6 columns of masonry of 9000 feet horizontal section having to support in the air, at 90 feet from the foundation, 44,000 feet superficial of roadway, weighing some score thousands of tons, and to bear the never-ceasing shaking of all the heavy-loaded waggons that can get on to it. The situation also requiring that the massive wooden framing for the arches should not obstruct the navigation of the river.
Materials, a soft limestone except the aforesaid casings. The world then being young, stone would probably be easy to cut.	Materials, principally the hardest granite, 3 or 4000 years older, and therefore, it is conceived, much harder.

* And some killed on purpose to keep the construction secret.

† There are more chambers undiscovered, no doubt, but those known are the chief, being in the centre.

‡ This is most probably the work of later hands than those which built the pyramid.—See "Modern Traveller," Egypt, p. 364.

§ Taking length and breadth together.

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PYRAMID OF CHEOPS.	NEW LONDON BRIDGE.
Stones close on the spot, some weighing 10 tons.	Stones brought 300 or 400 miles, some weighing near 20 tons.
No scaffolding required, the side of the pyramid being an inclined plane, up which the stones would be easily conveyed. The large stones might be cut out of the middle rock in shaping it, and rolled down hill into place.	Immense coffer-dams and centres necessary, of strength to sustain enormous pressure. Every stone dragged up by a crane perpendicularly. An extensive apparatus of steam-engines, pile-engines, pumps, &c., which need not be particularized.
Dimensions.	
746 feet long, 746 feet broad, 461 high, from which deduct the core of natural rock.	2000 feet long including approaches, 55 broad above water, 70 or 80 below, 80 feet high from foundation in the water, from which deduct void spaces of the arches.
Appearance.	
An unnatural mountain, which if it stood in England would be called Mr. Cheops' "Folly."*	A sublime and beautiful monument of human strength and wisdom. A flying-bridge.
Utility.	
Case to keep Cheops' carcase safe for 3000 years till the Egyptian resurrection! Or the bones of the sacred bull! Or to secure the booty plundered from the people. Or any conceivable purpose but an adequate or rational one.	Convenient thoroughfare for the greatest tide of traffic in the world; saving many lives and much property annually lost under the old bridge.
To stand as an everlasting monument of Egypt's wealth and power, which motive had not probably a feather's weight compared with the more important ones above.	To perpetuate the wealth and power of the City of London (as a secondary consideration).
With the most favourable shape and climate, has stood 3 or 4000 years, and will stand till doomsday.	With most unfavourable shape and climate, will stand as long as granite holds together.

To strike a Balance.

Put size out of the question, and it will be seen that in design, execution, and end, the bridge is the work of a superior order of beings to those who built the pyramid, and as to size, if the competition is, who shall build the highest heap of stone, without regard to utility, man is a fool to the coral worms. Even the white ants of Africa are more respectable pyramid builders than the Egyptians; for some of their erections are 10 feet high or 240 times their own length, whereas the great pyramid is but 80 times the height of a man. The great pyramid is supposed to contain 6 million tons of stone, of which half may be natural rock, leaving 3 million tons of artificial erection.

Plymouth Breakwater, an invaluable work, contains 2 million tons of stone, and Cherbourg Breakwater, in France, I believe, has still more. It is needless to say that the great pyramid could be beaten in bulk 10 times over if the English nation willed it, which they are not likely to do till they all inhabit lunatic asylums.

I look upon the pyramids as the

* He who maintains the shape of the pyramids to be sublime, independent of size, will some day be found reverencing the dunghill in his garden.

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sublime foolscaps of the ancient Egyptians.

I am, Sir,
Yours, &c.
J. BROWN, Jun.

P.S.—Some of the dimensions used above are in round numbers, but they are quite accurate enough for the strength of the argument. Let it also be remembered that the question is one of judgment and not of feeling. This apology is for the antiquary and the man of taste.

INTERESTING EXPERIMENTS WITH CANAL-BOATS.

We regard the experiments described below as extremely important. If the result is correctly stated, and if no counteracting disadvantage has escaped notice, we think these experiments may be said to have added a million sterling to the value of canal property in Great Britain, since they must at no distant period, add fifty or a hundred thousand pounds to the annual dividends. Nothing can be more paradoxical or startling in appearance than this result; and yet our knowledge of the many unexpected truths in mechanical science which experiment has brought to light, will not permit us to reject it as incredible. It is this; *that the surge generated in a canal by the motion of a boat, and which is so destructive to the banks, in moderately rapid motions* (such as 4 or 5 miles an hour), *ceases altogether when a high velocity is employed.* It is true the vessels were of a particular construction, but this is immaterial. A boat 60 feet long and 5 feet wide is capable of being extremely serviceable, both for the conveyance of goods and passengers; and if such a boat can be safely and conveniently dragged at the rate of 9 or 10 miles an hour upon our canals, passengers by this species of conveyance will be upon a level as to speed with those who travel per mail. The great recommendations of canal carriage at present are its cheapness, and the liberty of locomotion which passengers enjoy. Its leading disadvantage is its slowness; and this is felt now more and more, when our stage-coaches are touching a speed of ten miles an hour, which will soon be doubled on our railways. We have not technical skill enough to know what a gig-boat is; but we infer from the other particulars stated, that it must be flat-bottomed in the cross section, pretty well curved upwards at stem and stern, and very light. With this form, the quicker it is moved, the less water it will draw. At a very high velocity, it will merely skim the surface as it were; the displacement of the fluid will reach only a few inches down; and this circumstance, with the quick motion of the boat, causing a re-adjustment of the equilibrium of the water equally rapid, the necessary time will be wanting for the motion to propagate itself beyond the narrow zone of water which immediately encompasses the boat. Such is our hypothesis, supposing the fact to be as stated. We have a strong impression, however, that the result depends chiefly on the form of the boat, and that a much greater breadth than five feet will be no material disadvantage, except where the canal is extremely narrow.—*Edinburgh Advertiser.*

Some months ago, by the suggestion of Mr. William Houston of Johnstone, the Committee of Management of the Ardrossan and Paisley Canal were induced to make certain experiments for ascertaining the rate of velocity at which a light gig-boat might be propelled along that canal. The experiments were made with a gig-rowing boat of about 30 feet in length, constructed by Mr. Hunter, boat-builder, Brown-street, Glasgow; and this boat, with 10 men on board, was drawn two miles along the Ardrossan or Paisley Canal, in the space of less than 10 minutes, without raising any surge or commotion on the water—the force employed being one horse, rode by a canal-driver. No account of this trial has ever been given to the public, but it was so satisfactory as to induce the Committee of the Ardrossan Canal to contract with Mr. Wood, of Port Glasgow, for a gig-shaped pas-

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sage-boat, 60 feet in length, and 8 feet in breadth, fitted to carry from 36 to 40 passengers. In the month of April last, a number of experiments were made in the Forth and Clyde Canal with two gig-boats fixed together, constructed by Mr. Hunter, and thus forming what is called a twin-boat. The object of these trials was to ascertain the rate of speed at which vessels might be propelled along that canal, and the effect of a light double or twin-boat, in giving that degree of steadiness which it was apprehended would be so much wanting in a light single boat. A statement of these experiments on the Forth and Clyde Canal has already appeared in the newspapers, and the only fact therein mentioned, which it seems necessary to repeat here, is the remarkable circumstance, that the quicker the boats were propelled through the water, the less appearance there was of a surge or wave on the sides of the canal. The result of the experiment was so satisfactory, that a twin-boat of a gig shape, 60 feet in length, and 9 feet broad, is at present building by Mr. Hunter, Brown-street, Glasgow, and will be launched in the Forth and Clyde Canal in the course of the present month.

The single gig-shaped passage-boat, contracted for by the Ardrossan Canal Committee, was launched at Port Glasgow on Wednesday se'ennight, the 2d of June, and she was towed up to the Broomielaw, and thence carried to Port Eglinton the day following; and on Friday, the 4th of June, a trial, of which the following is an account, took place. The boat is 60 feet long, 4 feet 6 inches breadth of beam, and drew on an average, including a deep keel, 10 inches when light:—

From the great hurry in which this trial was made, it was done under many disadvantages. The boat started from Port Eglinton for Paisley a few minutes after one o'clock, with 20 persons on board, and the distance from Port Eglinton to Paisley being 7 miles, was accomplished in 1 hour and 7 minutes. The rider was ordered to start and proceed the first mile or so at a very moderate pace, but even at this moderate pace the wave raised in front of the boat was very considerable. A high wave was seen on the canal preceding the boat, about 80 or 90 feet in front, and in some cases farther, and causing an overflow at the bridges, and in the narrow parts of the canal. The surge or cutting wave behind the boat was, however, comparatively slight, and except at the curves, would not have caused much injury to the canal-banks. The horse was very much exhausted when he got to Paisley, though by no means so exhausted as he was about the middle of the journey, having sensibly recovered after the first four or five miles.

Two post-horses were hired there; and lighter towing-lines being attached to the boat, it started again, on its return to Glasgow, with 24 persons on board, 4 of whom were boys, and arrived at Glasgow, a distance of 7 miles, in 45 minutes. The greatest speed attained during the journey was 2 miles in 11 minutes. During this voyage the surge behind was entirely got quit of, even at the curves, where it was reduced to nothing; and there was no front wave, except at the bridges. It appeared only at the bridges, and just as the boat was about to enter under the bridge, and gradually disappeared as the stern of the boat cleared the bridge. *The quicker the boat went, the more entire was the disappearance of all wave and surge*, except where the water escaped in the centre of the canal, and met in two very noisy and rapid currents from each side of the boat at the rudder. This noise and rush of water was so great behind as to induce persons on board to look round expecting to see a great wave or surge on the bank of the canal, but on the banks there was hardly a ripple. The two rapid, noisy currents seemed to be completely spent and exhausted by the shock of their concourse behind the boat. Here, therefore, there was no room to doubt of the correctness of the reports of the Forth and Clyde Canal experiments. It was not merely to be said that the greater the speed the less the surge or wave, but it was demonstrated that *at a high rate of speed, surge and wave were done away with altogether*. Unluckily, there was no dynamometer attached to the rope, so as to ascertain whether, contrary to all theory, the strain or pull was not equally diminished with the wave, and the tugging labour of the two horses lessened instead of increased, by the accelerated rate at which they drew the boat. There can be no doubt, however, that with one trained horse, properly attached, the distance could be done in a period under 40 minutes. Contrary to expectation, Mr. Wood's boat was quite fit

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the water, and by no means crank. It may be proper to mention that the Ardrossan Canal is throughout very narrow; at the bridges and many other places it is only 9 feet broad. It has a great number of turns, and many of them very sudden.—*Glasgow Chronicle.*

FIRE-PROOF HOUSES.

Observations on the Report, &c. of the Associated Architects in 1792-3, on the Causes of the frequent Fires in London, and the best means for the Prevention of the same.

BY MR. C. DAVY, ARCHITECT.

(*Continued from page 205.*)

Fire-proof houses have, at different periods, occupied the attention of men of science, and "The Resolutions of the Associated Architects" is not the only work that has been written on the subject. There is one (an octavo, dedicated to W. Beckford, Esq.) that the readers of the "Mechanics' Magazine" may, in all probability, be unacquainted with. I shall, on several occasions, have to refer particularly to this work; I therefore subjoin the title of the work and the preventions of the ingenious author.

"The manner of Securing all Sorts of Buildings from Fire; or, a Treatise upon the Construction of Arches, and a Roof without Timber, called a Brick Roof, &c. &c Translated from the French of Le Compte D'Espie. By L. Dutens."

"The invention is this, to erect a roof* of such construction (which three years ago I myself built on my house at Thoulouse) as to be absolutely composed of no other materials than bricks, mortar, and plaster, there being no wood or iron in the whole formation of it, and, therefore, I give it the name of a bricked roof. This roof is supported by flat arches, and is of a wonderful and particular texture; as to its work, some may descry it because they know not the use of it, or because it at present appears new, but it is a method of building in Rousillon, very old and of great antiquity; yet has this method but lately been brought into the adjacent provinces of France, and about Thoulouse, in Languedoc.

"The Duke of Belleisle gave the first idea of these arches in this country. He sent workmen from Perpignan to build him these kind of arches in his house at Bissey; these men being more skilful in this method than artists from any where else."—p. 7.

Having previously stated the objects of the "association of architects," and given the names of its leading members I proceed to remark upon and explain the nature of the experiments and the results. The report, which occupies nine pages, contains matter of much moment. The first circumstance that attracted the consideration of the members was, "the causes of the frequent fires." In most of my papers I have endeavoured to impress on the minds of those concerned the absolute necessity of ascertaining, to the full extent, the "origin of fires;" for it appears to me, that instead of striking at the root of the evil, the questions hitherto considered have been—1st, how to escape from danger? and 2nd, what method is best adapted for the prevention of fire? Now the origin of fires, properly considered, will have the effect of lessening the danger to a great extent, for should it be proved to arise from malconstruction of houses in general, then the object might be attained by directing the attention of the legislature to the propriety of repeating the present building act for a greater safeguard to lives and property.

The next point considered in the report is:—"*The present mode of insuring buildings, furniture, and stock in trade.*" On this subject the report observes:—

"The practice of the fire offices is, to pay the sum insured on the house, or to re-build; although the sum so paid, or the building so re-constructed, may be very considerably superior in value to the building destroyed: hence a temptation is held out to incendiaries to insure very old dilapidated buildings for large sums and set them on fire, in order to get, for a small

*The same principle is applied to other parts of the building.

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premium, a large sum of money, or a new house. The recompense for the damage done to furniture and stock in trade depends on the affidavit of the insurer, which is afterwards violated, and about which the offices are not so strict as they might be, conceiving that they promoted their business by lessening the trouble attendant on the recovery of losses."—p. 15.

Observations.—The truth of these remarks is manifest enough, and requires serious consideration. Let any one cast their eyes over the frequent accounts of fires in the daily papers, and he will perceive the usual termination of such reports are, "it is not known *how the fire originated*"—"*the cause* of the fire is involved in mystery"—"not the slightest clue can be obtained *as to the origin of the fire*," &c. &c.

3. "The injudicious manner in which stoves, grates, coppers, and furnaces, are frequently fixed."

Observations.—Among many old houses which appear to have undergone certain alterations in the 17th and 18th centuries, are to be found peculiarities more or less dangerous in cases of fire. Little fear need be apprehended from the comfortable chimney-corners abounding in the real old English mansions: but in proportion as luxury advanced, borne on by that tide of fashion which so often sets at defiance all real enjoyment, the chimney-corners, dog-irons, and wood fuel, gave way for grates of much narrower capacity. The massive beams that upheld the chimney, breast, and other timbers that ran *through the flues*, were, strange to say, allowed to remain subjected to an intensity of heat, from the difference in fuel and the height of the stoves, which brought them nearer in contact with the wood.* In modern buildings iron chimney-bars are used instead of the beams, but the stoves are not, I consider, perfectly safe, being set much too forward. *Apropos* of old buildings, Is it not to be regretted that the *window-seats and lockers* are discontinued? Excellent depositaries could be formed for fire-escapes, by having in the highest and most isolated apartment a reel fitted in the interior of the lockers, round which a portable rope-ladder might be coiled; they would be constantly ready, and in such a situation as to prevent the possibility of their either being overlooked or forgotten. Indeed, the present window-backs might be battened out a few inches, and cupboards or enclosures might be formed therein.

A few words on the stoves employed in workshops and factories will conclude these observations on the third branch of the "Report." There are some description of buildings containing ranges of workshops where the chances of pure accident are very great; these are carpenters', cabinet-makers' shops, and the like. The construction of their stoves is rude and deficient in the extreme. Carpenters' stoves, in many instances, are raised so short a distance from the ground, that the fuel employed to feed them (viz. saw-dust and shavings), will, unless great care is taken, easily communicate with the highly combustible materials scattered around; and whatever pains may be taken to extinguish the same, we are seldom certain that those efforts are completely effectual. Saw-dust, in particular, will smoulder for a great length of time. The unfortunate manufactory of Messrs. Stoddart and Co., pianoforte-makers, has been sacrificed two or three times, although, as usual, no one knows how. I am of opinion, that these stoves should be constructed after the manner of those used for chemical purposes, and that they should be supplied with fuel through a hopper-head. Of coppers it may be said, that the absurd practice of conveying the flue into the kitchen-chimney is equally open to reprehension.

C. D.

P. S.—By way of postscript, permit me to say a few words on the communication of your correspondent "Vulcan" in your last Number. Your correspondent commences by requesting criticisms on the new

* I have known several houses to take fire from these beams igniting—two in Holborn, which were fortunately discovered in time, and one in Fleet Market very lately.

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brestsummer; he then proceeds to condemn it altogether, and ultimately gives us to understand that he is one of the least scientific of your readers. I regret to take notice of these inconsistencies, but after the unqualified condemnation he has been pleased to pass upon the builder or constructor, such observations should not be permitted to pass unnoticed. I am fearful that "Vulcan," in addition to his lameness, is labouring under the same inconvenience as his workmen in the smithy. So far from the brestsummer being constructed upon a bad principle, it is quite the reverse, being both judicious and scientific. Your correspondent should have turned to some former Numbers of the "Mechanics Magazine," and he would have found Conder's suspension truss-girder described; and also a girder on the same principle, supporting some tons' weight of liquor, at Nicholson's Distillery. In addition, I can inform him, that girders on this *frightful* principle are employed at the London University; and also that flat brick-arches, supporting an enormous weight, are *prevented* from *acting upon their abutments* by a tie-bar, nuts, and screws. Lastly, without the same principle, suspension-bridges never would have appeared. So much, then, for the principle; now for the arrangement. As your correspondent has not favoured us with the span of the front, or any of the scantlings, except the bar, this question cannot be fairly discussed; but if the span is within 20 feet, I should feel no hesitation in ordering another 4 stories to be added to the present height of the house, provided the 2 tie-bars are, as he says, 2 inches in diameter, and the brestsummer of the *usual* dimensions. As to the screws at the extremity, I should hope "Vulcan" is aware that in proportion to the thrust, so should the number of threads be increased in the nut till it would be impossible for the superincumbent weight to need the aid of any abutment except the nuts and screws, *unless* the tie-bars were drawn asunder. In answering his inquiries concerning church-roofs, I shall in a future paper return to this subject.

ALLEGED INFRINGEMENT OF PATENT-RIGHT.

Court of Chancery, July 31, 1830.

LORD COCHRANE AND MR. ALEXANDER GALLOWAY *v.* MESSRS. BRAITHWAITE AND ERICSSON.

Additional Affidavits.

Since this case was last before the Lord Chancellor (see "Mech. Mag." No. 361), the plaintiffs have filed seventeen additional affidavits, touching chiefly the point of usage on which his Lordship at the last hearing required to have farther evidence:—

1. Mr. Galloway, one of the plaintiffs, saith, that he has erected *two* boilers with air-tight furnaces, and magazines for supplying such furnaces with fuel, the one boiler for working a condensing-engine, and the other for a high-pressure engine; both of which boilers are constructed conformable to, and in accordance with the specification filed by the deponent under the patent granted to him and his co-plaintiff, Lord Cochrane; that the condensing-boiler, constructed agreeably to their specification, has been in constant practical operation for the last six months, daily working the steam-engine, which drives the machinery in the deponent's manufactory. That it has been viewed whilst working by upwards of 500 persons, who have witnessed its successful performance, and the great benefits resulting from its use.

2. Mr. John Farey saith, that he has examined a steam-boiler at Mr. Galloway's manufactory, which is constructed according to the plaintiffs' specification, *for* it has an air-tight furnace or fire-place included within it, and surrounded by the water, which is to be converted into steam, and a supply of atmospheric air is forced by a bellows-pump through a pipe into the fire-place beneath the fire-grate, on which the burning fuel rests; and the heated gas, flames, and smoke, proceeding from the fire, after passing through a long course of horizontal tubing it escapes from the extreme end thereof *through an upright pipe* (marked V in the drawing in "Mech. Mag." No. 361), which is not high enough to act as a chimney, nor large enough to allow the heated gas

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to pass without obstruction and crowding, whereby the air and heated gas within the close furnace is maintained under a slight force of compression; and the fuel is supplied to the close fire-place from the top of the boiler by means of an ante-chamber with its external door, and also an internal door between that ante-chamber and the fire-place; one of which doors being closed before the other is opened, fresh fuel is introduced into the furnace when requisite, without permitting any considerable escape of the heated air. And this deponent farther saith, that he has examined the said boiler when it was in action to supply steam for working a steam-engine on Mr. Galloway's premises, when it operated very completely, and that it is, in his opinion, a useful and beneficial invention.

8—8. The Hon. W. Erskine Cochrane, Mr. Francis Bramah, Mr. Edmund Turrell, Dr. Birkbeck, Mr. Perkins, Mr. Brunel—all declare nearly in the same words that they have seen the boiler exhibited at Mr. Galloway's manufactory when in actual operation; that it is constructed according to the plaintiffs' specification, and that they believe it to be an invention "both practically useful and beneficial."

9. Mr. John Alexander Galloway saith, that he has superintended the manufacture of *several* air-tight furnaces and magazines for steam-boilers, made in strict conformity to, and in accordance with, the specification and drawings of the patent granted to the plaintiffs. And that one of these air-tight furnaces and magazines with a boiler has been attached to and is in constant use in generating steam for the supply of the steam-engines employed in working the machinery in Mr. Galloway's manufactory.

10. Mr. John Richter, of Islington, saith, that he has attended many times and carefully watched for several hours at a time the operation of the steam-engine boiler and furnace by which the extensive machinery and works of Mr. Galloway are kept in operation. That from his knowledge of the effect and use of steam, particularly as applied to sugar-refining and as a moving power, he is enabled to judge thereof, and declares that the said boiler and furnace are constructed in perfect conformity with the specification of the plaintiffs; and that the furnace and boiler fully answer the expectations set forth in the said specification, in saving expense in fuel, occupying a smaller space, and in not requiring the usual high chimney, and also in destroying every appearance of smoke. That the said furnace requires much less attention in feeding the same; which operation is much less laborious, and not attended with the usual inconvenience of excessive heat. And that the plaintiffs' invention is in every respect important and valuable.

11. Mr. Partington, of the London Institution, saith, that he has witnessed at Mr. Galloway's the operation of a boiler made in exact accordance with the plaintiffs' specification; and that it contains a series of new improvements of the greatest importance in the generation of steam for a variety of purposes. That he has examined the specification of Messrs. Braithwaite and Ericsson, and "has no hesitation in giving it as his positive opinion, that all the essentially useful parts of the latter are borrowed from or are exactly similar to those previously specified in the patent of Lord Cochrane and Alexander Galloway."

12. Mr. Sylvester, clerk to Mr. Harmer, solicitor, saith, that he sent by Mr. Galloway's instructions a letter to each of the persons who had made affidavits on the part of the defendants, stating, that Mr. Galloway was desirous to remove from their minds the erroneous impression they appeared to entertain with regard to the practicability and utility of his invention, "and would be therefore obliged by their calling at his manufactory to see the furnace and boiler in operation."

13. Mr. Richard Hodgson Galloway saith, that "he is able unequivocally to state that both patents are substantially for the same purpose, and, consequently, on account of the priority of the date of the plaintiffs' patent, the defendants' patent is a clear and palpable infringement on that of the plaintiffs." Saith farther, that from the constant successful performance of the boiler exhibited at Mr. Galloway's manufactory, "which he has daily witnessed and attentively observed *during the last five months*, and from the many advantages it possesses over all boilers hitherto made, deponent has no hesitation in declaring it to be a most ingenious, useful, and meritorious invention, which must, in his opinion, produce a new and important æra in steam operations, and cannot

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fall to be of great public utility and advantage."

14. Mr. William Wallace, civil-engineer, states it to be his "unqualified opinion, that the patent obtained by the defendants is a direct and palpable infringement of the patent obtained by the plaintiffs;" and declareth farther, nearly in the same terms as the deponents, No. 3 to No. 8.

15, 16. Mr William Russell, engineer, and Mr. Joseph Rayner, engineer, give testimony similar to that of Mr. Wallace.

17. Mr. Joshua Horton, of Great Bridge, near Birmingham, saith, that he has been most extensively engaged for the last 28 years in manufacturing every description of steam-boilers, and is perfectly acquainted with the improved boiler invented by the plaintiffs. That he has witnessed at Mr. Galloway's manufactory the practical operation of a steam-boiler constructed with an air-tight furnace and magazine for the supply of such furnace with fuel, made strictly in accordance with the plaintiffs' specification of 1818, and which boiler was generating steam for working the steam-engine employed in giving motion to the whole of the machinery in Mr. Galloway's manufactory. And that the said boiler acted most perfectly, and that the invention of the plaintiffs is important, useful, and meritorious.

For the defendants there have been also filed eight additional affidavits.

1. Mr. William Braithwaite saith, that he was present and directed certain trials made with a boiler constructed on the principles of the patent of the defendants, for the purpose of calculating the power and capabilities thereof—That the results of such trials were, that the boiler evaporated upwards of 7 cubic feet of water in one hour, which produces a sufficient quantity of steam to supply a steam-engine of seven-horse power; and that in the course of such trials the deponent carefully measured the surface exposed to the action of the heat in the said boiler, and that the same was 15½ superficial heat, which is little less than 2¼ superficial feet to each horse power. That up to the time of the defendants' invention becoming known, the deponent always considered that it was the universally acknowledged opinion of experienced engineers, that it was necessary to present at the least eight feet of assize to the action of the fire for each respective horse power to be obtained; and for the better supporting deponent's opinion in this behalf, he craves leave to refer to a work on the steam-engine, compiled by one John Farey (who has given evidence in this cause on behalf of the plaintiffs), wherein it is written, at p. 580, as follows:—"The heating of the boiler should be at the rate of 36—3÷3=12—1 square foot to each horse power that the engine is required to exert, say 12 square feet. This is the proportion which is now most commonly followed, and it will give a sufficiency of steam without any unreasonable wear of the boiler; but it is the opinion of the most experienced engineers, that a greater quantity of steam will be produced from a given consumption of fuel, if more surface is given to the boiler, even as much as 15 or 18 square feet to each horse power." That if a boiler were constructed on the common principle of boilers, it would require at least a surface of 56 feet to produce the quantity of steam before stated to be produced by the boiler of the defendants'. That to the best of the deponent's judgment and experience, he considers it impossible that the plaintiffs could reduce the size of their boiler, if the same was in accordance with the specification, as the object is to *retain the heat* within the flues, whereby it is a necessary consequence that such flues should be even more capacious than the common flues when the atmospheric draught suffers the air to pass uninterruptedly through the same; but that the principle of the defendants' boiler is to reduce the size of the flues, and to cause a great quantity of heated air to pass through them at a greater velocity than hitherto known. That the objects of the two inventions are not only different, but that the results which deponent has witnessed produced from the defendants' boiler, renders it impossible that the same could be produced by a boiler made in accordance with the plaintiffs' specification.

2. Mr. George Husband saith, that he worked with Mr. Galloway, as a turner, from February, 1826, to March last, and that during that time no machine was ever made by Mr. Galloway on the plan set forth in the plaintiffs' specification.

3. Mr. T. F. Crumpton, who was also formerly a workman in Mr. Galloway's manufactory, makes an affidavit to the same effect, as regards all the time

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between September, 1808, and July, 1824.

4. Mary Ann Bird, widow, saith, in 1821, the deponent sailed in a vessel called "The Rising Star," bound for Valparaiso, in company with her husband (now deceased), who was then engaged, together with one Joseph Green, by Lord Cochrane, as engineer to the said vessel, it being intended that the vessel should be fitted out with two steam-engines, made conformably to the principles of a patent then recently obtained by Lord Cochrane and Mr. Galloway. That the vessel was fitted with a temporary bottom, in order that the engines should be more easily fixed at sea, and trials made under the direction and superintendence of Lord Cochrane, who was then at Lima, and had agreed to meet the vessel for that purpose on her arrival at Valparaiso. That the vessel carried out the two engines on board, and that on her arrival at Valparaiso she was joined by Lord Cochrane, who proceeded forthwith to remove the temporary bottom, and to fit the engines to the vessel. That many fruitless and dangerous attempts were made in the presence of the deponent to effect the object intended; and that the same proving entirely abortive, Lord Cochrane thereupon erected two large chimneys on board the vessel, one for each engine, for the purpose of carrying off the smoke. That the only occasion on which it was attempted to work the vessel by these engines was on a pleasure excursion from Valparaiso to Canteira, with the governor of Valparaiso and other friends of Lord Cochrane on board; but that the engines became almost immediately out of repair, and the vessel was with difficulty got back safe to Valparaiso. That Lord Cochrane then abandoned all hopes of success, and proceeded to dismantle the vessel of her engines.

5. Mr. Trevethick swears, that a drawing produced in the cause is a correct representation of the boiler for which he took out a patent in 1804, and *inter alia* that his furnace or fire-place "was supplied with fuel from above, which fuel was dropped down vertically upon the fire."

6. Dr. Andrew Ure, professor of chemistry, saith, that he has most attentively studied the specifications of the two parties, and that he is perfectly convinced that they differ essentially in their principles, their objects, and their modes of action. That the whole tenor of the plaintiffs' specification proves the *principle* to be, to burn fuel by the agency of artificially condensed air in air-tight chambers—the *object* to be to keep this air in a stagnant state till it has imparted its heat to the surrounding water—and *the mode of action* to be by intermitted interjections and emissions of condensed air. That he is certain from his knowledge of the nature of the chemical process of combustion, and from his ample experience in applying fuel to the production of steam, that the contrivances which the plaintiffs claim in their specification as peculiar, and what are denominated air-tight stoves, furnaces, &c., are utterly fallacious in design, and must prove abortive in practice. But that in the defendants' invention, the *principle* is to burn fuel by a most rapid current of air, artificially created, either by propulsion inwards or extraction outwards—the *object* is to draw that ignited aerial stream closely along the surface of a flue of relatively small diameter, which thereby becomes most rapidly and economically heated—and its *mode of action* is by a non-intermitting closely continuous issue of the burned air. That he is confident, from his acquaintance with the chemical theory of combustion, and with the mode of formation of steam, as well as from observation of the actual performance of the defendants' scheme of converting liquids into vapour, that their invention is truly philosophical, most effective, and worthy of all the protection due to an original idea, pregnant with the most beneficial results to human society, and in particular to the arts of this country. That he regards their machine indeed as constituting an era in the history of the steam-engine no less important than that of James Watt, whose happy scheme of the separate condenser it is calculated to supersede, with a saving of first cost and economy in use. That he looks on the plaintiffs' machine as nearly inoperative till deprived of its patented peculiarities—that is, the air-tight valves and the air-tight cover on the top of the chimney secured with a screw—and then the machine becomes an ordinary boiler or fire on the common principle, which the plaintiffs disclaim.

7. Mr. Francis Cooke, engineer, saith, that he has worked for Mr. Galloway for nearly three years, and is at present in his employ. That the boiler exhibited at work in Mr. Gal-

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loway's manufactory has been erected within four months from the present time. That he has been shown a drawing of a boiler as described in the plaintiffs' specification, and that there is not the slightest similarity between that drawing and the boiler in operation. That there has been only one other boiler erected on Mr. Galloway's premises during the time the deponent has worked for him, which deponent declares to be within the last eight weeks. That he was present at and assisted when repeated trials were made with the said boiler. That the chimney (Y) was used when the fire was lighted to get up the steam, and the column of water (D) was placed at the end of the flue. That the steam was got up as in an ordinary boiler; and that when the steam was up to a pressure equal to 60 pounds on the square inch, the chimney (Y) was then closed as described in the plaintiffs' drawing, and the heated air forced through the flues into the column of water by means of a blowing cylinder: the result of which was, the fire became black, and the steam rapidly went down, and in a few minutes the chimney was obliged to be opened, otherwise the fire would have been completely extinguished. That the boiler never worked ten minutes with the air forced through the column of water; and that the boiler now in operation does not remove the inconvenience of smoke, but, on the contrary, deponent thinks that more smoke is made by their boiler than by one on the common principle when coals are used.

8. Mr. Charles Frederick Cheffins, mechanical draughtsman, saith, that on the 27th July, 1830, he went to the manufactory of Mr. Galloway, and saw the boiler exhibited by him in operation. There was no vessel containing a column of water attached to said boiler, but that, on the contrary, there was a considerable quantity of smoke issuing out from the upper extremity of the upright open pipe or chimney (Y). He asked Mr. Galloway, jun., where said column of water was placed, so as to afford resistance to the passage of the heated air? That Mr. Galloway, jun. told him they did not use a column of water to this boiler, but that in order to obtain a resistance they had diminished the area of the upright open pipe or chimney, so that its area should be less than the area of the flue in the boiler (but which area, to the best of the deponent's judgment, was more than thirty square inches; that is to say, the pipe measured five inches by eight), thereby effecting the desir d object. That deponent farther observed, that the ante-chamber or magazine through which the furnace was supplied with fuel was not surrounded by water, as represented in the plaintiffs' specification and drawing. That the deponent considers that the plaintiffs have been enabled to dispense with such contrivance, from the reason that the heated air, instead of being subjected to a considerable pressure at the end of the flues, is suffered to escape freely into the atmosphere through an open pipe or chimney, whose sectional area, to the best of deponent's belief, measures five inches by eight inches. That upon asking Mr. Galloway, jun. how long said boiler had been in operation, he was answered, that it had been in constant work for seven months. That a boiler was shown to deponent constructed with a vessel to contain water, and an upright tube similar to drawing in plaintiffs' specification, but which deponent was informed had only been used for experiments, and that the said boiler was not in operation at the time deponent saw it.

Judgment.

Lord Chancellor.—Mr. Horne, with respect to that case of Cochrane and Braithwaite, correct me if I am wrong with respect to those affidavits handed in, which I was to look at, respecting the patent for steam-engines; I do not find that Mr. Galloway carries back the use of the boiler beyond six months. I have read the affidavits.

Mr. Horne.—I am sorry to say that the affidavits were handed to me, but I handed them to your lordship, and I did not read them.

Lord Chancellor.—I do not find that he carries back the use of his boiler above six months. Previously to that time it appears he was, to a certain degree, making experiments. Now the patent of Mr. Braithwaite is one year and a half old, and it is dated in January, 1829; so that this boiler which Mr. Galloway is now showing was, in point of fact, not in use till one year after Mr. Braithwaite's patent was obtained. Under these circumstances, I think the parties ought to be left to try their right at law, and the injunction to be dissolved. It is quite unnecessary for

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me, in this state of things, to give any opinion with respect to the patent; but this much, however, I will state, I have read the specification with attention, and the evidence, and it appears to me that the objects of the two patents are different; and that the principle of the two patents, as far as relates to the object, appears to me to be different. It is said, and said with some truth, that if Mr. Galloway was the inventor of a machine which he applies to one purpose, another person cannot make use of that machine for another purpose; but then Mr. Galloway claims, according to the phraseology, abstract parts of this machine, and the combination of the machine only with respect to the objects to which it is directed; that object appears to me to be very different to the object to which Mr. Braithwaite's is directed; on that part of the case it is unnecessary for me to express any opinion. I think the injunction ought to be dissolved, and the parties ought to have an opportunity of trying it, if they think proper, in a court of law.

Mr. Horne.—I do not know whether your lordship had ever granted the injunction—I believe it was a motion for an injunction.

Lord Chancellor.—Then I certainly shall not grant the injunction.

Mr. Horne.—We will see how that is.

Lord Chancellor.—It was not an *ex-parte* injunction?

Mr. Horne.—No.

Lord Chancellor.—I think you are right; under such circumstances I shall not grant the injunction.

Mr. Horne.—Does your lordship say any thing about the costs?

Lord Chancellor.—I should rather reserve the consideration of the costs, if the action is brought, till after that action is decided.

Mr. Horne.—Your lordship refuses the injunction—leaving it to Mr. Galloway, if he thinks proper, to bring an action with liberty to the parties to apply?

Lord Chancellor.—Yes, and reserve the consideration of the costs till after the action is disposed of; if it should not be brought within a reasonable time the parties to be at liberty to apply for the costs.

Remarks.

We were never more satisfied with the justice of any decision; and though in a legal sense it is but of a preliminary nature, we look upon it as, in reality, decisive of the question at issue between the parties. It will be observed that his lordship has refused the injunction, not on the ground merely of the plaintiffs having never made use of their invention till within the last 6 months, but for this more important reason, that the rival inventions are substantially different—an opinion to which his lordship states he has come *after having himself attentively examined the specifications of the two parties.* The judgment is, in truth, one upon the whole merits of the case; and it has been pronounced by a judge, of whom it is no mere form of speech to say, that he is our highest legal authority *in matters of science*—perhaps the very highest that ever graced the judgment-seat.

We have something better, however, than mere *authority* to show for the faith that is in us. We, too, have examined for ourselves, and very minutely, the whole of the papers in the case; and we now propose to unburthen ourselves (not without profit, we trust, to our readers) of a crowd of considerations, all tending more or less to illustrate the justice of the decision which has been pronounced.

The point of *non-usage*, which holds the foremost place in the Chancellor's judgment, appears to us to stand a great deal more unfavourably for the plaintiffs (even on their own showing) than his lordship has assumed. Their affidavits do not carry back the use of their engine even to so short a period as six months; in fact, they prove no use at all. Not one of all the scientific persons, who swear that the boiler, exhibited in operation at Mr. Galloway's manufactory, is "made and constructed conformable to, and in accordance with, the specification" of the plaintiffs, swears that he saw *it working in the mode set forth in that specification.* Now, it is scarcely necessary to say, that this is by no means a matter of necessary inference. There may have been a vessel appointed to hold water, and no water in it; a valve intended to be weighted, and no weight upon it; or a chimney, directed to be kept close, left open. None of the plaintiffs' affidavit-makers appears to have thought of ascertaining how these matters were—none of them at least has sworn that they were

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as the patent directs, when he saw the boiler in operation; and, not having so sworn, all they have sworn is nothing to the purpose. We must except, indeed, Mr. Farey, who, after giving a singularly strong affidavit in favour of the plaintiffs—dwelling much on the efficacy of the weighted valve, and the compression obtained by it—now admits, in his additional affidavit, that "the heated gas, flames, and smoke," do *not* force their way through that valve, but quietly "escape from the extreme end (of the horizontal flue) THROUGH AN UPRIGHT PIPE, which is not high enough to act as a chimney," &c. "THROUGH AN UPRIGHT PIPE!" The plaintiffs say distinctly in their specification, that when that pipe (marked Y in the engraving of the plaintiffs' engine, "Mechanics' Magazine," No. 361) is so used, the apparatus is "on the common principle," and "forms no part of our invention."

Even the affidavits of Mr. Galloway himself, and of his two sons, fall as short of the requisite proof as those of their learned auxiliaries; they do not swear that any boiler has ever been worked in the mode set forth in the plaintiffs' specification—the practicability and utility of which mode is the point to be established.

We purposely refrain from drawing any aid to this view of the case from the affidavits produced on the part of the defendants; for, in the first place, we have no liking for the evidence of tattling, and, perhaps, discarded servants; and, in the second, it may suffice to show, as we shall afterwards have occasion to do, that the plaintiffs have failed in proving a use of their boiler in the mode set forth in their specification, simply because it is physically impossible so to use it.

When the non-usage of an invention arises, as it not unfrequently does, from mere neglect, or from deficiency of means, or from want of adequate encouragement, it is but an ungracious sort of argument on which to rest a defence of an imputed infringement; but where it resolves itself (as in the present instance) into a challenge to prove the practicability of the invention, it is one of the fairest weapons of defence which can be employed, inasmuch as it is but the shortest way to the truth.

Putting usage, however, out of the question, let us now consider what real *difference* there is between the two inventions. In order to understand more clearly in what this difference consists, it will be proper to notice, in the first place, one or two things which are common to, and material to both parties, but are the invention of neither.

First,—There is the application of a pair of bellows to accelerate the process of combustion, and to augment the quantity of heat generated; that is to say, the application of the bellows, which is an invention of unrecorded antiquity, to the particular purposes of a steam-engine. Neither of the present parties has the least claim to the invention of this application. It is now exactly a century since the same thing was suggested (it is believed for the first time), by Dr. John Allen, in his "Specimina Ichnographia, 1730." (The precise words of Dr. A. will be afterwards quoted.) There was also (as noticed by a correspondent in our 361st Number) a patent taken out by Mr. Trevethick, in 1802, which included the use of "bellows to excite the fire;" and another by Messrs. Fox and Lean, in 1812, in which they claim the right to "inject or force in air through a pipe or pipes, by any of the *well-known* mechanical means for producing or affording a blast," &c.

Secondly.—There is the contrivance of carrying the flue of the furnace, by a circuitous course, through the water which is to be evaporated. This also is not new by a century at least: it appears, in conjunction with the use of the bellows, in the work by Dr. Allen, which has been just quoted. The following is the entire passage, embracing both contrivances:—

"From the fire-place is to be continued a *large copper worm about* 15 *inches diameter, and about* 40 *feet in length*, as is visible in the figure; by which contrivance the flame-heated air and smoke are retained more than three times as long as the other (alluding to a previous mode of construction, in which an ascending flue of one bend is employed), which is a very singular privilege and advantage in this form: the contact of the copper against the water to be heated is far more extensive than in the other; all other things relating to it are much the same. If this should not be found to have draft enough, barely by the admission of it (air) at the grate, *a large pair of bellows* may be found necessary."—*Ichnographia, Diss.* 1, *Art.* 8.

Now let us see what remains to each of the present parties, after separating from their inventions the bellows and the flue, neither of which it is clear is new.

The *plaintiffs* have certain contriv-

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ances for keeping their furnaces *air-tight*, and obstructing or restraining the escape of the heated air and smoke into the atmosphere. Neither Dr. Allen nor Mr. Trevethick, nor Messrs. Fox and Lane, were at any pains to prevent the air having access to the furnace—as well through the door of the furnace as through the pipe of the bellows—and they all agree in making the flue terminate in the open air. Lord Cochrane and Mr. Galloway on the contrary think it necessary in order to obtain the effects sought for by their engine, that not a particle of air should enter into the furnace except what is forced through the pipe of the bellows, and that not a particle shall escape except by forcing up a loaded valve at the end of the flue, which opens the way into a column of water. This flue, it is necessary to observe, has a biforked termination; one branch Y is called a chimney, and directed by their specification to be left open at first getting up the fire, after which it is to be kept closed by an air-tight cover; the other (marked A in the engravings), is that which has the valve at the end opening into the column of water. The plaintiffs say, that when a certain cover I I, which fits air-tight into the mouth of the furnace, "is opened to admit freely and copiously the atmospheric air *under the fire*," and when the chimney Y is left open "for carrying off the smoke," then their furnace "is a fire on the common principle, and when *used in that state, forms no part of our invention*;" but that when certain "covers or valves" (enumerating them) "are shut by any sufficient machinery, and *rendered air-tight* in those parts, and a full supply of atmospheric air is forced into the fire at the place or places assigned for its entrance, then such a change and combination in the machinery *puts this part of the principle of our invention in full force*."

After the smoke has been thus confined "until it is deprived by the action of the fire of any required quantity of its combustible properties," the plaintiffs compel it to go through the column of water (D), by which they say "it is cleansed of some of its mucilaginous properties," and so purified that "it may either be collected for any useful object, or allowed to escape into the atmosphere without creating the inconvenience and annoyance generally experienced from the exit of foul smoke from any ordinary chimney."

In the two purposes thus supposed to be effected, namely, the retention of the smoke for a time in order to extract from it "its combustible properties," and its ultimate consumption, or at least purification, *all that is peculiar* to the invention of the plaintiffs consists. Take away the valves or covers by which their furnace is kept air-tight, and take away the column of water by which the smoke is said to be purified, and you leave them nothing which they can claim as their own.

Now, before proceeding to inquire what the opposite parties have accomplished, let us pause for a moment to ascertain whether an engine constructed on the plan which has been patented by the plaintiffs, would *really* effect the objects proposed by it?

Several sufficient reasons may be given why it could not do so. 1. The plaintiffs do not specify *what the weight should be* with which the valve or plate C, the raising of which is to permit of the ultimate escape of the smoke, should be loaded; but let us suppose the weight to be such a column of water as is represented in their own drawings—such a column as they say will be "required to perform the double object" of confining the smoke until it is deprived of its combustible properties, and afterwards cleansing and purifying it. It is quite certain that *before a valve so loaded could be raised, the fire would be blown out* (see on this point the evidence of Francis Cooke): an excess of cold air, forced into an air-tight furnace, must have precisely the same effect as if an excess of cold water were thrown upon it. 2. But let us suppose the valve once raised, it must, *if the engine is to go on working*, continue raised; and in that case, there will be an end, so far as regards that valve, of the compression which forms the principle of this invention. Dr. Ure, in his affidavit, describes the "mode of action" patented by the plaintiffs to be one by "*intermitted* injections and emissions of condensed air;" but if this be the interpretation we are to bestow on the words of the specification, it will only serve to make matters worse; for an engine working by such intermissions, would on that account alone be absolutely useless. 3. Were the valve, however, even once raised, one of two effects must ensue; either that the water (being the denser body) would rush up the flue and put out the fire, or that the hot blast would blow

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out the water in the form of steam, so that whether as regards the valve or the water, the contrivance would be equally abortive.*

No wonder, then, that the plaintiffs have not proved any use of their engine according to the mode of operation set forth in their specification; for to prove that would be to prove an impossibility.

But let us see farther in what the invention of the defendants differs from that of the plaintiffs, and in what its substantial originality consists.

The defendants do not, like the plaintiffs, require that the body of their stove should be air-tight (for a reason which will be immediately apparent), neither is it air-tight in any part. Air is admitted into their furnace through the grating under it, as well as through the bellows-pipe. The lids of the hopper, by which the fuel is supplied, fit, as the Lord Chancellor observed; but not more so than any other lids may be said to fit.

Again, the defendants do *not* obstruct the ultimate escape of the waste air into the atmosphere in the sense that the defendants obstruct it. Their flue terminates in the open atmosphere; that of the plaintiffs in a column of water. Their flue has no stopper; that of the plaintiffs has. The consequence is, that in the engine of the defendants the products of combustion flow in a *constant and continuous stream* through the flue into the atmosphere, while in that of the defendants the stream is obstructed—*stopped* till a certain degree of compression is obtained; the difference is as great as between motion and rest.

It has been said that the same pressure which the plaintiffs obtain by means of their valve or stopper and column of water, the defendants obtain by means of "a diminished size of the flue of the furnace." This is a very erroneous view of the matter. The pressures obtained are of a perfectly different description. The sort of pressure which the defendants obtain by means of their flue is common to all furnaces with flues; and flues have been from time immemorial of all sizes and shapes, wide and narrow, crooked and straight. The object ordinarily sought by this pressure, or rather compression, is to *produce a draught*. The pressure which the plaintiffs effect is of a description quite peculiar to themselves, and of the right to which no person is ever likely to deprive them; it has for its object *not to produce a draught* as a flue does, but to *stop* the draught produced by the flue—to stop it absolutely for a given time till certain (imaginary) purposes are accomplished.

If, then, there is any "colourable imitation" in the case it must consist in this, that the defendants have imitated the plaintiffs' mode of *stopping* a draught by a mode which *removes all stoppage*. The most extraordinary sort of imitation that, perhaps, ever was heard of!

The circumstance of the defendants' flue being left open at its extremity, explains how that *air-tightness*, which the plaintiffs insist so much upon, is of no consequence in the case of the defendants' engine. The strong and continuous draught through the flue, which is established and kept up by the joint operation of forcing the air in at one extremity, and allowing it to escape freely at the other, draws naturally all the products of combustion within its vortex. The plaintiffs

* Since writing the above observations, we learn from a contemporary that this absurd application of a valve to stop the progress of the heated air, &c.—this master-feature of the plaintiff's invention—is not so new as we have taken for granted. It formed the subject, it appears, of a patent granted to Mr. Thomas Rowntree, of Great Surrey-street, Blackfriars, on the 16th of May, 1798. "This patentee," says our contemporary, "was an ignorant man himself, and probably employed (as is the custom at the present day) as ignorant a man to prepare his specification. The consequence was, his patent was set aside by Lord Eldon on the ground that the specification was not sufficiently clear, to enable an ordinary person in the line of business to which it relates, to construct an apparatus like that which the patentee proposed; but the real nature and principle of the arrangement was explained by the evidence brought forward by the patentee to support his monopoly. From this evidence we will make only a single extract, which is sufficient to satisfy the most sceptical.

"Mr. Hindmarsh stated, 'that it further consisted in the elevated situation and smallness of the aperture leading from the furnace towards the chimney; whereby the flame and hot air are impeded in their progress to the atmosphere, and *compelled to tarry* in the cavity of the furnace, and occupy every part thereof much longer than they otherwise would do. This effect in *stopping*, *checking*, and as it were *arresting* the flame and hot air in their attempt to escape into the atmosphere, Mr. Hindmarsh considered as not only new, but singularly beneficial; for by this means the flame and hot air are detained in the very place where their presence is most wanted, and constrained to give forth their energies with an *impetus* against the bottoms and sides of the vessel to be heated; whereas, in none of the furnaces heretofore erected, was *any effectual stop* interposed between the fire and the chimney, to cause the flame and hot air to dwell under and round the sides of the vessel; but they passed rapidly off into the atmosphere, either by a direct communication through the chimney, or indirectly, but almost as speedily, by flues.'"—*Register of Arts.*

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on the contrary by stopping the mouth of their flue with a heavily loaded valve, produce as naturally a tendency in the smoke and hot air to escape through every less guarded avenue; and were their furnace not in every part air-tight—were there a single crevice through which access could be obtained to the open air—not all the power that could be exerted at the bellows would ever force that valve open.

The plaintiffs say that the object of the *detention*, effected by the valve and column of water, is, that the smoke "may be deprived by the action of the fire of any required quantity of its combustible properties;" that is *their* way of augmenting the heat, and aiding the generation of steam. Now, whether right or wrong, this is not the way adopted by the defendants, who contend, on the contrary, that the less detention the better—that the more *rapidly* and *uninterruptedly* the products of combustion are driven through the flue, the more abundant will be the heat produced.

The case may be usefully illustrated by an example, drawn from a more familiar element. One man erects a dam across a shallow stream in order to obtain water enough to turn a mill; another seeks to obtain the same object by straightening and contracting its banks, and thus gathering the waters within a narrower channel, and giving greater rapidity and impetus to their passage. The objects of both are the same; the means essentially different. Lord Cochrane and Mr. Galloway are in the situation of the dam-makers; Messrs. Braithwaite and Ericsson in that of the embankers.

The plaintiffs say farther, that they consume or purify the smoke by making it pass through a column of water: the defendants consume their smoke now without the aid of any column of water—a difference of *effect*, which proves of itself the existence of some essential difference in the construction of the two engines.

The chief points on which this difference turns remain yet to be noticed. In making their flue terminate in the open air, and in not making the body of their furnace air-tight, the defendants have only followed in the steps of many preceding inventors, however much they may differ from the plaintiffs. But there are one or two particulars in which they stand quite alone, separated and distinguished not only from the plaintiffs, but from all who have preceded them.

It has been always hitherto considered, that the larger the heating surfaces placed in contact with the water to be evaporated the better. There have been many learned papers written for the purpose of demonstrating the existence of such a principle, and many patents taken out for contrivances, founded on the assumption of its correctness. The impression generally prevalent among engine-makers and engine-users has been, that the advantage to be obtained from the use of a large boiler is only limited by considerations of convenience, and that there could not be any *very effective engine* with a *very small boiler*. This fact is very well adverted to in the affidavit of Mr. Wm. Braithwaite (one of the most important produced in the case, and deserving of every engineer's particular consideration), who quotes Mr. Farey's book on steam-engines, to show that twelve square feet to each horse power, has been the proportion most commonly followed; but that, in the opinion of "the most experienced engineers," more steam would be generated if "more surface" were given to the boiler; "even so much as fifteen or eighteen square feet to each horse power."

In order to increase the quantity of heating surface, without increasing the bulk, tubular engines were introduced—that is to say, engines in which the water, instead of being contained in one large boiler, was contained in a number of small tubes, and the hot air circulated around and among them. Even in those more philosophically constructed engines, in which tubes have been employed for conveying the hot air *through the cold water*, instead of the cold water through the hot air, the tubes have been still of very *large* dimensions. The engine of the plaintiffs forms no exception to this remark.

Now, it has been reserved to the defendants to furnish practical evidence that this notion is entirely erroneous. In this respect, their originality is unquestionable. They have produced a boiler, which, according to the evidence of Mr. Laird the most extensive boiler-maker in the kingdom, is "superior to any boiler hitherto known;" and in which nevertheless the extent of heating *surface is less than was ever before employed*. According to the evidence of Mr. Wm. Braithwaite before referred to, a boiler of seven horse power was efficiently worked by a boiler which had only *two and a half* superficial feet of surface

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for each horse power; that is to say, the extent of surface required has been actually reduced full four-fifths!

Well may that acute and able chemist Dr. Ure say, that the invention which has produced such a result as this constitutes "an æra in the history of the steam-engine." The mere saving of engine-room, which is thus effected, is an incalculable advantage. The objection of bulk once removed, the application of steam-agency to locomotion by land and sea, must proceed with rapid strides.

The plan which the defendants have adopted is founded upon two considerations, which have not hitherto been sufficiently attended to—the great conducting power of metal tubes, and the amazing quantity of heat which water is capable of containing in a latent state. Probably the fact may have been before observed that metal, in contact with water, takes up and transmits to the water any heat applied to it, with almost *instantaneous rapidity*; but every one before the defendants seems to have missed the very natural inference, that, since the transmission is so instantaneous, *a very small metallic surface may suffice to transmit as large a quantity of heat in a given time as you can possibly bring in contact with it.*

The engine of the defendants has been constructed on the strength of this inference, and with a degree of success which shows that it was an inference as just as it was natural. They describe correctly the distinguishing feature of their invention, when they say that it "consists in causing a rapid formation of steam by *forcing an extraordinary quantity of caloric into the liquid in a given time.*" The means by which they force in this extraordinary quantity are not all new, separately considered; but they are new in their combination for this particular purpose. They make use of a pair of bellows to drive the heated air with rapidity through the flue, which as has been already shown is not new; they employ an extremely small flue of a tapering form, but neither is this new; for there have been from of old flues of all sizes, and the worms of stills taper. But the flue of the defendants, besides being extremely small and tapering, has a *constantly descending direction;* and this, it is believed, is quite new, the flues of furnaces having been hitherto universally made to take an ascending direction. Then as to the combination of all those expedients; namely, the employment of a blast to drive an extraordinary quantity of heated air through a small, tapering, and descending flue, in order that "an extraordinary quantity of caloric" may be forced into the water in a given time—it is such a combination as we shall look for in vain in all the thousand and one plans previously prepared for the better generation of steam.

The advantages derived from the smallness of the flue, its tapering form, and descending direction, require a little elucidation. They are not all equally apparent.

The smallness of the flue makes it difficult for any particle of the stream of hot air to escape without coming in contact with its sides (the great object sought to be effected).

The *tapering form of the flue* serves to maintain the current of hot air at an equal velocity throughout its whole course; the diminished pressure of the blast towards the termination of the flue being compensated for by the corresponding diminution in the size of the flue.

The *descending direction of the flue* opposes a downward resistance to the column of hot air, which makes it impinge with greater violence against the sides of the flue, and thus increases prodigiously the rapidity with which the particles of heat are given off to the metal, every particle being as instantly absorbed as resisted, and its place supplied by another which follows the same law.

The more rapid generation of steam, which is the result of all these contrivances, is not the only beneficial result obtained; for it so happens that though the consumption of smoke formed no part of the object included in the patent of the defendants, it is a decided consequence of the mode of construction which they have adopted for the generation of steam.

Where, then, are we to find that clashing similarity between the inventions of the two parties, which should have entitled the plaintiffs to the injunction sought for?

Does it consist in the use of an air-tight stove? The defendants do not use one.

Or in the use of a stopper to the flue of the furnace? The defendants use no stopper.

Or in the use of a column of water to purify the smoke? The defendants do not use a column of water.

And if there be no similarity in the

of these points, how can there be any similarity at all?

Mark, on the other hand, what differences exist between the two inventions!

The principle of the plaintiffs' invention consists in stopping the stream of hot air for a time. Were the defendants to stop the stream in their case for an instant, the whole purpose of their invention would be defeated.

The plaintiffs seek to gain nothing by rapidity of operation; with the defendants' rapidity of operation is every thing.

The plaintiffs use a flue of the old and common construction; the defendants have devised a flue of a perfectly new form, and better calculated for the transmission of heat than any before known.

The plaintiffs obviate the inconvenience of smoke by passing it through a column of water; the defendants consume their smoke by the action of the hot air.

The plaintiffs have invented an engine which will not work at all (in the way they propose); the defendants have invented an engine which works to admiration, and which a multitude of witnesses, alike distinguished for practical experience and scientific knowledge, have agreed in recognising as one of the most useful and important inventions of modern times.

J. C. R.

Mr. Galloway to the Editor of the "Mechanics' Magazine."

Sir,—I have this moment learned that it is your intention to publish in your next Number the decision of the Lord Chancellor in refusing me an injunction against Messrs. Braithwaite and Ericsson for their glaring and important infringement on my patent steam-boiler, together with the affidavits that have been made since the second hearing of the case. I am very glad that you have adopted this course, because it will afford me the means of contrasting the affidavits of the plaintiffs with those of the defendants, as well as remarking upon the unworthy means to which the defendants have resorted, to procure several of those affidavits.

I beg to inform your readers, that although the Chancellor has refused me the injunction at this time, still he has reserved his decision of costs until I shall have appealed to a court of law for the protection of my patent-rights against the manifest invasions of Messrs. Braithwaite and Ericsson; and I shall with all possible dispatch employ the necessary measures to secure to myself and co-plaintiff the benefits of such a remedy.

I am, Sir,

Yours respectfully,

ALEXANDER GALLOWAY.

August 4, 1830.

SIR ISAAC NEWTON'S ARITHMETICAL QUESTION.

Sir,—I perfectly agree with Mr. N. Logan in his remarks on Sir Isaac Newton's question (vol. xiii. p. 360), that the growth of the grass should be considered uniform, from the beginning of the times *c*, *f*, and *h*. For, in the first place, Newton directly states so in his enunciation to the question, and it is evident he meant so from his solution, the first part of which is as follows:—

"If the oxen *a*, in the time *c*, eat up the pasture *b*; then by proportion the oxen $\frac{c}{b}a$ in the time *c*, or the oxen $\frac{cc}{bf}a$ in the time *f*, or the oxen $\frac{cc}{bh}a$ in the time *h*, will eat up the pasture *e*, supposing the grass did not grow at all after the time *c*. But since by reason of the growth of the grass," &c.

From the above it is abundantly evident that Newton did not suppose that there was no growth of the grass during the time *c*. The truth is, Newton was too rigid an observer of the laws of nature ever to propose a question that involved a physical impossibility. But farther, although Mr. Samuel Latham has thought proper to change the enunciation of Newton's

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question, I can find nothing in his own solution that can tend to warrant the alteration he has made. The fact is, his solution seems to be nearly the same as that of Newton's, where Newton gives the results of certain proportions. Mr. Samuel Latham has (if I may be allowed a school phrase) stated the proportions, &c.; but, in justice to Mr. Samuel Latham, I must say, that if we could suppose the grass to grow, or stop growing, at the word of command, and solve the question according to his enunciation, the result would be the same.

G. S.'s solutions to this question are, by far, the best I have ever seen. His corollary to his general solution is the only part I cannot rightly understand. Perhaps he will have the kindness to make it more intelligible.

I am, Sir,

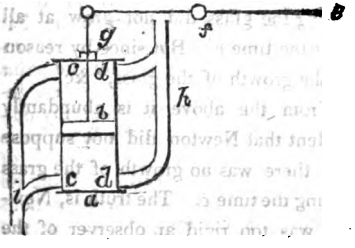
Yours, &c.

A CAMBRIDGE STUDENT.

August 3, 1830.

[Mr. Utting's letter on the same subject in our next.]

DOUBLE POWER PUMP.



Sir,—A friend having given me a sketch of a pump of his invention, which appears to him and to me new, I send you a sketch of it for insertion in your useful miscellany; and if you should think it worthy a place therein, the opinions of some of your correspondents, experienced in such matters, is respectfully solicited, and if favourable, the name of the inventor shall be communicated. It seems likely to be useful for fire-engines, as a continuous stream must be produced by it.

a, cylinder or barrel.
b, piston without a valve.
c, situation of suction-pipe valves, opening outwards from the barrel.
d, situation of the outlet-pipe valves, opening as above.
e, handle.
f, fulcrum.
g, stuffing-box.
h, outlet-pipe.
i, suction-pipe.

I am, Sir,

Yours, &c.

BENEVOLUS.

BAMBOO LADDERS.

Sir,—Though much ingenuity has been employed in the invention of numerous varieties of fire-escapes, it appears to me that they are all too expensive and too cumbersome to be brought into general use; and that the common ladder is still the most serviceable safeguard for lives and property in cases of fire. I beg leave to suggest for the consideration of your scientific and practical readers, whether it would not be a great improvement in fire-escape ladders to have them constructed of bamboo; to those who are unacquainted with this magnificent cane, it may be necessary to say, that its strength exceeds that of any spar of the same dimensions, while its extreme lightness renders it so portable, that it could be raised with one-third of the power that would be required for a common ladder. Bamboo may be obtained of sufficient length to reach the second-story windows; and where a greater elevation is required, a short ladder might be lashed on with security, for the bamboo having so little weight of its own to support, the strain would not be too great on the part joined. The cost of a bamboo ladder would not exceed 2*l.* or 3*l.*, and they might

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be made two or three feet in width, which would afford great security to to those unaccustomed to such decents.

I remain, Sir,

Yours, &c.

I. G.

Aldermanbury, June 28, 1830.

INVOLUTE AND EPICYCLOIDAL TEETH.

—— "There were ample reasons for it, none
Of which he specified in this his pleading;
His speech was a fine sample, on the whole,
Of rhetoric, which the learned call 'rigmarole.'"

Sir,—I see nothing in Mr. Harrison's attempt in No. 363 to mystify a subject which he seems incapable of elucidating, that renders it necessary for me to make a single remark on his letter; and I leave it without comment, to be judged of and appreciated by your readers, according to their opinion of its merits.

For reasons which you are already acquainted with, I decline pursuing that subject as I purposed, when I wrote my last paper upon it.* But I promised your readers I would have teeth made of the full size of those mentioned by Dr. Robison, and I have accordingly done so. The length of the surface rubbed or slid over was measured in the manner I have described in No. 359.

The slide of an involute tooth (shown in No. 353, page 168), three inches long, belonging to a wheel ten feet diameter, acting on a tooth of a wheel two feet diameter, is $1\frac{1}{4}$ inches instead of $\frac{1}{6}$ as stated by Dr. Robison, or of $\frac{2}{3}$ as determined by Mr. Harrison, by the rule he has given in No. 363, or some other equally good.

The slide of straight teeth (No. 329, page 238,) on the same sized wheels is $1\frac{1}{4}$ inches.

Of epicycloidal teeth (No. 359), on wheels of the same size, the slide is $2\frac{1}{12}$ inches. When the ten-feet wheel was the driver, this tooth required to be four inches long.

In all these trials the ten feet wheel moved through $6\frac{2}{3}$ degrees.

Involute teeth, three inches long, on two wheels ten feet diameter, slide on each other $\frac{1}{12}$ of an inch.

Straight teeth, on the same sized wheels, slide the same.

Epicycloidal teeth, on the same wheels, slide $1\frac{1}{16}$ inches.

In these three cases the wheels moved through ten degrees.

Straight teeth are altogether out of the question; but I have given the measure of their slide, which, in one of the cases named above, is exactly the same as that of involute teeth, to show the importance of Mr. Harrison's "curvity and obliquity" which he talks so much about.

Mr. H., with that courtesy for which all his papers are so remarkable, says, I "ignorantly persisted" that involute teeth had very little friction. My "ignorance" of the subject is of such a nature, if it is ignorance, that it has not been dispelled by Mr. Harrison's endeavours to enlighten me; but I suppose he has done his best to do so, and I therefore feel obliged to him for the pains he has taken. I must, however, inform him, that, so far from my opinion that "the best teeth for wheels are those formed by involutes of circles" being altered by any thing he has written, or by the investigations which I have entered into myself respecting them, it is confirmed. For although they are not so free from friction as Dr. Robison believed they were, nor even so much so as I thought them, yet, I find upon examination, they possess many important

* It is quite proper that our readers should know what these "reasons" are. In No. 359, page 263, there was a drawing of involute teeth given in illustration of a paper by our present correspondent S. Y., which was only half the size it was intended to have been, and withal not excessively exact. S. Y. was angry that these things should be, and insisted that we should have a new engraving executed of the teeth "as big as life," and "done to a hair" (such at least was the substance of his demand). We replied, that we had no objection to do any thing that was "reasonable," but that we saw nothing in the defects complained of, which affected in the least the explanation which the engraving was designed to illustrate. The teeth might be smaller than the original, and the lines not very well formed; but every person could easily see what was meant. S. Y. has not, however, been satisfied; and so, because we wont stultify our work to gratify his mere whim, we are doomed to lose the continuation of his correspondence on this particular subject.—Ed. M. M.

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advantages over epicycloidal teeth, which I had not attributed to them.

I do not intend to resume this subject in your pages, and I conclude by asking Mr. Harrison if he has any practical knowledge of involute teeth more than he has stated of the two wheels in a water-mill? Of his theoretical knowledge of teeth of any sort, he has kindly furnished us with ample means of forming an accurate opinion.

And now for Mr. Harrison's blustering postscript.—In it he says he shall "point out instances of unfairness and want of truth" in my papers.

As I am quite unconscious of having made a single false statement, and most decidedly never meant to do so, I shall feel obliged by their being pointed out; and I certainly consider, after having charged me with "unfairness and want of truth," Mr. H. is bound by the principles of common honesty to inform us upon what he grounds these charges.

I have certainly accused Mr. Harrison of having made very great blunders; among the rest with having stated, and repeated, that two widely different ratios were one and the same ratio—with having absurdly said over and over again that one thing was a part or portion of another, which other was of a perfectly different nature—with having given a measure of the variation of pendulums (a thing he ought to understand above all others), which is grossly erroneous; and with having put forth notions of his own as principles in science, which are principles no where but in his own imagination. All this I have given some proofs of, and am ready to give more if necessary. I shall, however, be very happy to pay every attention to any proof Mr. Harrison may bring of the correctness of his principles, or the truth of his statements; but I must tell him candidly, that if he attempts to support his opinions by papers of the same description as he has given us a sample of in your 363d Number, I shall not trouble you with any reply to them; for I never will occupy your pages or my own time in disputing with a man who can establish the truth of his declarations by no other means than reiterated assertions of their truth; and whose efforts, in spite of his denial of the fact, are evidently directed to merely silencing his opponents, and establishing his own opinions whether right or wrong.*

This language may by some be thought too harsh. I must request they will bear in mind that I am addressing a man who has "ignorantly persisted," to use a phrase of his own, in occupying your pages with papers that are worse than useless; for the errors they contain come to us authorised by the name of an individual who ought, and is, likely to be generally supposed completely master of the subjects on which he thinks proper to write, and whose opinions are supported by arguments which seem admirably adapted to confuse the ideas of his readers, and obscure the truth; all which renders them very likely to be adopted without examination, and makes the exposure of their fallacy imperatively necessary for the good of your readers.

If I have laid down any principle in your work, the truth of which is not evident, I will thank any of your readers to point it out; when, if I cannot prove its truth, I shall be able to make the best amends a man can make who has misled others—candidly confess myself mistaken when I made the statement.

Yours, respectfully,

S. Y., an Engineer.

July 26, 1830.

P. S.—The diagram in No. 359, page 263, is not "the drawing S. Y. has given," but one that your engraver has given for him, which is only half

* Mr. H., finding his model of involute teeth proved much more than he intended it should, now says, "there is, however, evident data," from which the slide may be shown—without one, I suppose; and talks of his "long experience." Does he conclude, because he has been accustomed to none but epicycloidal teeth, that, therefore, they must be the best? That there are data sufficient I am as well aware, as I am that Mr. Harrison has made no use of them; and that he has given convincing proof of not knowing what they are. But, as Mr. H. observes, models are "admirably adapted" to show the action of the teeth; the method is his own, and he ought to be satisfied with results obtained by it. They give ocular demonstration, and may be constructed by many persons who could not appreciate a more scientific mode of elucidation. For these, and the reasons named in my last, I made use of them.

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the size it was intended to have been, and the curves of which are very ill formed.

HINTS TO WRANGLERS AND PLAGIARY HUNTERS.

Sir,—"I pity the man who will travel from Dan to Beersheba, and cry all his barren." So said Sterne; and in such sentiment I am ready most fully to concur. I am sorry for the man who, whenever a new invention is proposed for discussion, instead of discussing its intrinsic and practical merits, gropes back into by-gone years, and rummages over old volumes and musty transactions to discover that the invention is not new. Why, the wise man says there is nothing new under the sun; then let such depreciators of talent always be ready to cry out "It is not new," and they have said their say. For their zeal in the pursuit of old ideas to prove others new revived, outruns their discretion and their judgment. Being blinded (perhaps conveniently), they see not that two men may hit on the same, or nearly the same, thought, and yet that thought be original with both. A striking instance occurred in the case of Dr. Johnson and Voltaire, who were both engaged on a work separate from each other, which, when produced (and they were so nearly at the same time), bore in the plot and moral so striking a similarity, that had it been possible for one to have seen the other's before his own was at the press, he would have scarcely been able to persuade the world that he had not borrowed from that which he had chanced to see before his own was published. Where no great interests are concerned, and when vaunting and lying pretensions are not made, I cannot, for my part, see what good object is effected by the proclamation of "So you see it is not so new as Mr. So-and-so's friends have imagined." Before this is said, the assertor should be well assured that the invention denounced is a robbery, either bold felony or petty larceny.

I have been induced to throw these hints into a form, from the hope that some good may be effected by your allowing them a place in your valuable Miscellany, of which I am not one of the youngest subscribers or contributors; being unfeignedly sorry to observe much of its space so frequently occupied by matter of discussion, which neither edifies nor improves. Repentance, too,—age having wrinkled my brow and sobered my judgment,—has some share in prompting me to offer you these hints, recollecting that I have myself transgressed in former days on your patience, and on the kindness of your readers. All the *amende honourable* I can make consists in warning my juniors of a rock on which their inexperience often throws them, where (without knowing it) they lie, and present an object of pity to the eyes of the more sober-minded among us. I know the difficult situation in which an editor is placed; his benevolence* often prompts him to exclude a piece which he sees is neither worthy of, nor honourable to, a contributor whose general assistance is useful and even valuable; but, knowing how easily vanity is piqued, and good intentions and motives mis-seen, he feels compelled, out of compliment to the contributor, to insert what he is aware would be far better consigned to the *dull* oblivious stream. Perhaps this hint will be taken into the cool consideration of your correspondents; and then I am sure they will feel how necessary it is for them to think before they write, censure, or condemn.

I am, Sir,
Yours, &c
July 31, 1830. T. M. B.

MODERN ANTIQUES—FRICTION WHEELS NOT NEW.

Friction wheels were recommended by Casatus, and afterwards mentioned by Stermius and Wolfius, about the middle of the seventeenth century, and were applied to actual use in clocks, by Sully, in the year 1716. Mondran applied them to cranes in 1725. In the 4th volume of the "Machines Approuvées par l'Aca-

* If it is not out of place, I would wish to record my humble opinion, that the Editor of the "Mechanics' Magazine" is, with all his faults, and he has some, a black swan among his brothers, a *rara avis in terris*.

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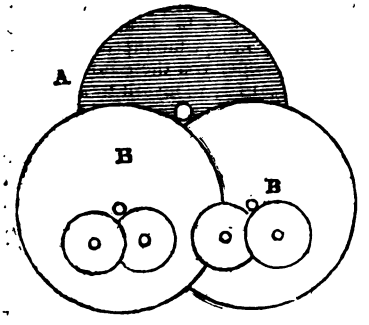
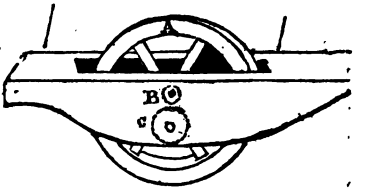
demie Royale," for the above year, there is a plate of Mondran's crane; the portion of it which is intended to diminish friction, is represented in the subjoined cut.



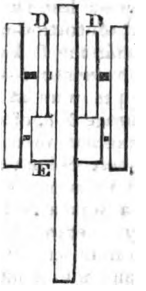
A is a wheel on the axis of the drum, around which the rope winds which is to sustain the load. This wheel is surrounded by cogs, and turned by a pinion, or lantern, which are not represented in the drawing. The axis of this wheel and drum rest upon the peripheries of the friction wheels BB, and these again upon the smaller friction wheels shown in the drawing. M. Mondran does not pretend to be the inventor of the friction rollers, but merely proposes to apply to cranes a contrivance before known. He says, "the beneficial effect of this invention has been experienced in many machines to which it has been applied. We find in the 'Memoirs of the Royal Society of Berlin,' published in 1710, a similar mode of preventing friction applied to pumps, since which time it has been used in clocks, and other machines, with perfect success.

"This manner of removing friction is not, perhaps, admissible in all cases, and particularly in machines intended for raising great weights, because the axis of the upper wheels acting directly downwards, must necessarily have a tendency to separate the friction wheels; the machine, nevertheless, is calculated to be *extensively* useful."

The next article in the same work, and under the same date, is a proposition by M. Mondran, to apply friction wheels to carriages. "This method," he observes, "of diminishing friction, consists in supporting the axis of a wheel upon two rollers only, instead of upon the four employed in



the preceding method. A is one of the wheels of a carriage, running in a suitable frame, there being a similar wheel on the opposite side; in each of the frames friction wheels are so placed, that the weight sustained by the axis of the wheel, B, may act vertically upon the axis of the rollers C. This is shown more plainly in the pro-



file, where the axle-tree, E, is seen resting upon the two rollers, DD; and in order that each axle may always keep its proper bearing, two trunnions are fixed within the edges of the openings through which it passes; they are so placed as by their lateral action to cause the weight to act vertically on the axis of the rollers DD. There will, therefore, be no tendency in the rollers to separate, as in the preceding machine. It necessarily follows that these rollers must have sufficient strength to sustain the weight which they are destined to bear perpendicularly."

We apprehend that this was actually the first proposition for the application of friction wheels to carriages, and we also apprehend that the mechanician has already seen that

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the friction wheels are placed upon the wrong side of the axle. M. Mondran had made his second machine upon paper, without adverting to the fact that, in the carriage, the load must press the axis in a direction the reverse of that of the crane. All that is necessary, therefore, to make the description correct, is to invert the figures; we did not feel ourselves at liberty to do so, in our copy, particularly as it appears to us that the mistake of M. Mondran tends to show the originality of the proposition.

We cannot see the difference between the friction rollers above proposed, and those recently claimed as novelties by certain patentees.—*Dr, Jones—Franklin Journal.*

FIRE-ENGINE SUCTION PIPES. INQUIRY ANSWERED.

Sir,—In reply to the inquiry of Mr. Moore, in your last number, on the construction of suction-pipes, I beg leave to submit the following, hoping it will meet his wishes:—

Suction-pipes were at first made as described at page 367, of short metallic cylinders, enclosed in a leather hose. But these short cylinders soon gave place to a continuous spiral strip of metal, which was also eventually superseded by a spiral helix of stout wire, enclosed in leather of a greater thickness than that at first used, and this constitutes all the improvements that have been made in the construction of *leather* suction-pipes up to the present time. As now made they are sufficiently flexible and not easily crushed, but very few are *air-tight* at first, and still fewer continue to be so for any length of time.

A great deal depends upon the leather being perfectly sound and the seam carefully closed; it is always advisable to use as short a suction-pipe as possible; they should never exceed seven feet; if a greater length is required, use two shorter lengths.

Hancock's *Caoutchouc* suctions, however, combine in a very high degree the necessary qualities of flexibility and strength, with the property of being *perfectly air tight*. If it be wished to keep a fire-engine in perfect order, whether the delivery hose be of leather or caoutchouc, I consider it absolutely necessary, that the *suction* pipe should be of the latter material.

It occurred to me some time since, that suction-pipes, and even delivery hose when great pressure is not to be sustained, made of painted canvas or sail-cloth, might be found to answer. A suction pipe, which I made in this manner, for a fire-engine of small dimensions, does exceedingly well; but how far it may succeed upon a larger scale remains yet to be ascertained.

The mode of painting to be employed is that invented by Mr. William Anderson, of H. M. dock-yard, Portsmouth, and described in the Transactions of the Society of Arts, vol. 26, page 135. It is briefly as follows:—Grind 96 lbs. of English ochre with boiled oil, and to it add 16 lbs. of black paint, which mixture forms an indifferent black. A pound of yellow soap, dissolved in six pints of water over the fire, is mixed while hot with the paint. This composition is then laid upon the canvas (without being wetted), as stiff as can conveniently be done with the brush, so as to form a smooth surface; the next, or still better, on the second day, a second coat of ochre and black (without any, or but a very small portion of soap) is laid on, and allowing this coat an intermediate day for drying, the canvas is then finished with black paint in the usual way. Canvas painted in this manner is pliable, durable, and impervious to water, without any stickiness or tendency of the paint to crack or peel off.

In conclusion I will just observe, that suction-pipes should always be kept as straight as possible; nothing injures them so much as continual bending about.

The straighter they are kept the longer will they continue useful, and the easier will it be to screw them on to the engine.

I am, sir,
Yours respectfully,
Wm. Baddeley.

August 3, 1830.

NEW CAMERA OBSCURA.

Mr. Editor,—I hope the following description of a little camera obscura may prove interesting to the curious

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and scientific. It makes manifest, by the rotary motion of a very fine screw, the cause why some are troubled with short sights and others with weak sights. Every motion it makes moves the little lens called the crystalline humour to and from the glass called the retina, and in each motion the instrument obscures the little inverted picture (save and except when its adjustment stands fair to fall even upon the retina), and by a change of two little lenses, the different degrees of short and weak sights experienced in the human eye are made manifest. The corrective glasses have a very pleasing effect when you place before the instrument, as you would before the eye, a suitable concave or convex number, according to the degree the instrument stands at. So decidedly does the instrument show the cause of difference in the natural eye, that I think it may not be inaptly called the little eye-crometer.

I remain, sir,
Your most obedient servant,
WM. JAMES, Optician.
27, *Little Russell-street, Bloomsbury.*

THOUGHTS ON THE FORMATION OF THE EARTH.

Sir,—I submit a few thoughts on the subject of geology, wishing you to publish them in your valuable Magazine, if you think them worthy of a place in it. As many writers have given their ideas on the subject, no doubt you will find many of mine are not new; yet I think, taking this essay as a whole, it will be found different from any account hitherto published on the subject.

I believe the generally received opinion is, that all things were created out of nothing, about six thousand years ago, and that in the space of six days: I think such an opinion not only opposed to reason, *but also to sacred writ.* If I understand the divine writer aright, he first tells us that in the beginning God created the heavens and the earth, and then he describes that chaotic mass of matter that existed at the time. Now, if that was created on the first day, when the Spirit of God moved on the face of the water, that seems to imply that it existed a long time in that state. If we allow that to have been created on the first day, we must allow that the heavens were also; and yet there is a distinct account of their creation *afterwards.* If the matter of our globe was in existence at the time creation is said to have commenced, we may conclude that the matter of the sun, moon, and planets, was likewise in existence. Allowing that to have been the case, that would remove an apparent inconsistency in the Mosaic account; that is, our earth, which contains but about a fourteen hundred thousandth part of the matter in our solar system, should be five days in creating, and the sun, moon, and stars, only one day. For when the sun received his luminous property, the moon and planets would appear to be brought into existence at the same time. By their receiving light from the sun, they would be visible to our earth, which before they could not be. Now, in respect to the six days in which the creation is said to have been carried on: when we find the interpretation put on a text contrary to reason and common sense, we conclude we have mistaken the meaning of the writer, and seek some other. When we look into the bowels of the earth, and examine the different strata of earth, the beds of sea-shells, fossil-bones, vegetables, &c. we find phenomena that cannot be satisfactorily accounted for any other way than by allowing the earth to have existed more than six thousand years. Some pretend to account for the whole by the universal deluge: but even allowing the sea to contain such a quantity of shells at the time, they could not have been carried there by the waters, and deposited in beds horizontally in the manner they are found; some would have been vertical, and in all positions, with their edges rounded and broken by friction; and as there must have been some thousands of the human race destroyed at the time, would not some of their remains have been found at different depths, as well as those of other animals?

But to return to the Mosaic account; we find the sun was not created till the fourth day. Now, if the day

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mentioned there is to be understood as a natural day, how, or by which cause, was the natural day produced, or by what was the length of it measured before the sun was created? May we not as well suppose the length of it to have been ten thousand years as twenty-four hours? For with God a day is as a thousand years, and a thousand years as one day.

In respect to matter, I believe it to be co-existent with the Divine Being. I have two reasons for such an idea: the first is, that if all matter be created, there must have been a time when the work of creation commenced; and whether that be six thousand or six millions of years ago, there must have been myriads of ages before that time. And without likening the Divine Being to one of ourselves, is it reasonable to suppose that so much power, wisdom, might, and intelligence, should have existed in a dormant state without having some work to carry on? My second reason is, when we view the starry heavens by the best telescopes, we have reason to believe they are infinite in extent, and if so, what is infinite in extent must have been so in duration? I do not mean to say that the starry heavens have always existed as they are now, many changes may have taken place; some stars may have been destroyed, and new ones brought into existence. Probably the Mosaic creation extended to our solar system only; I believe that no part of space is a complete vacuum, but that the whole is filled with a thin elastic aerial fluid, and that comets are agents employed in the work of creation—that they range through the etherial regions in all directions, collecting particles from this aerial fluid, and depositing them in the sun, or any planet that needs a supply. Is it not probable that the forty days' rain at the deluge was supplied from a comet? When orbicular motion was first given to our earth, it might have been some meteor or small body of matter; and by continuing its revolution for myriads of ages, collecting from this aerial fluid, a confused mass of matter might be gathered, like that described by Moses at the creation. And allowing the same process in nature to have taken place, as takes place in our day, air would be converted into water, and a mixture of different gases, &c. into solid matter. When in a fluid state it might not be a regular mixture; some parts might have a greater tendency to coagulate or become solid than others, and that would account for mountains and other irregularities. Probably animal creation was began about that time when the waters covered the earth; they might be habitable for shell-fish, polypi, &c. Then a new process in nature would begin—secondary formations would be produced: perhaps the first dry land that appeared might be the production of coralines. As larger portions of land became dry, it would produce vegetables, as moss, liverwort, &c. which, by their destruction, would form a mould-pit to support others, even trees after a time; and as the earth becomes habitable for different animals, no doubt they would be created. If we may take the order in which fossil remains of animals, are found, as described by Cuvier, and other writers, it would be, first (next to the primitive formation), shell-fish, polypi, &c.; next, fishes, amphibious animals, reptiles, birds, and quadrupeds; and lastly, the earth being filled with animals and vegetable productions, it would be a fit habitation for man.

From phenomena we see in the earth, we have reason to believe that by the action of the sea, rivers, &c. sea and dry land have progressively changed places several times, and that which is now the continent has been the bottom of the sea different times. Such a creation would not only be progressive as to time, but also as to the perfection of animals—the most imperfect would be created first, and last of all man, the prime and principal part.

Some may say why should creation have been progressive? Would it not have been as easy for that Being that created progressively, to have spoke the world into existence at once? Granted. But we see that would not be according to the laws of nature—all the works of God that we are acquainted with are progressive. If we saw a tree spring instantaneously out

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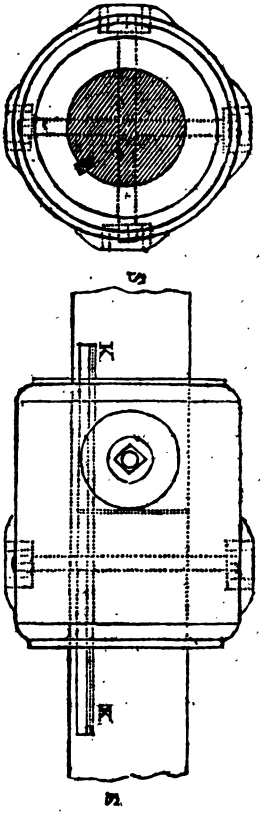
of the earth to its full size, we should call it a miracle; and to speak a world into existence, must be a greater miracle. But if we allow creation to have been carried on progressively (and that by a common process in nature), there is nothing more miraculous in it, than there is in the reproduction of animals or vegetables. One thing that I will advance by way of proof, is, that the same process of creation (as far as regards matter) is still going on: islands are forming in the sea by coraline substances, and soil is continually added to the earth by the destruction of animals and vegetables. That vegetables receive the greatest part of their nutriment and substance from air and water, may be proved by different experiments. Take pots of mould, plant different vegetables in them, and let them remain through their whole process, and there will be found an increase of mould. It may be likewise seen by the decomposition of vegetables, that they take but very little from the earth; and as animals are supported by vegetables, they cannot take any thing direct from the earth. If portions of the different strata of earth be submitted to chemical analysis, it will be found that they are chiefly composed of animal and vegetable productions. If our earth should be destroyed by fire, a certain degree of heat would convert the whole into a fluid; and a sufficient degree of heat continued, would dissipate the greatest part of it in fume or vapour. We should then have the earth converted into its original substance. As a proof that such a body of matter might be collected from a thin fluid, without its being much attenuated, let us suppose that all the solid matter in our solar system would form a globe of about nine hundred thousand miles in diameter; that reduced into cubic inches would produce about thirty-three places of figures (that is taking globes for cubes, which is near enough for our purpose) then allowing only a billion of miles for the diameter of space to our solar system, a billion involved to the third power would produce thirty-seven places of figures; so that there would not be a thousandth part of a cubic inch of matter to a cubic mile of space.

I am, Sir,
Your obedient servant,
THOMAS DAVY.

Woodbridge Road,
Ipswich.

IMPROVED COUPLING-BOX.



Sir,—Having frequently, and with the greatest concern, read accounts in the public prints of men falling victims to what I consider unaccountable neglect upon the part of machinists (viz. fitting coupling-boxes for the shafts of machinery, with the pins projecting in a most unnecessary manner), I beg leave to transmit you the accompanying sketch, in hopes that it may attract the attention of engineers,

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and induce them to alter the present bad system. Let bosses be cast upon the boxes as per sketch; these must be bored out to allow the bur to turn, and screw-pins used instead of the common pins. The heads and burs being by this means let in below the surface of the boss, cannot catch the dress of any workman who may chance to be throwing a strap on or off a drum, oiling, &c., close to any coupling. The drawing is to one inch scale. SS is the shaft, KK the key.

Your inserting this letter and sketch in your valuable Magazine, if considered worthy of attention, will much oblige

Your obedient servant,

R. C.

July 27, 1830.

MANUFACTURE OF STRAW HATS AT FLORENCE.

It is chiefly in the neighbourhood of Florence, Pisa, the district of Sienna, and in the upper part of the Valley of the Arno, that the best mats are made for straw hats. In these countries, whole families, old and young, may be seen occupied at this kind of work; and it is certain, that this branch of industry brings in a very large sum annually to the country. The cost of the raw material is inconsiderable; but the value of the work is so great, that the women of the Valley of the Arno commit their domestic affairs to people from the mountains, that they may be able to devote all their time to the lucrative manufacture of straw plat. The following is the information which the author of this notice has obtained relative to this kind of industry. The straw used in working these mats is grown in districts, mountainous and sterile. It is produced from a kind of wheat, of which the grain is very small. This straw, though slender, has much consistence, and the upper part of the stalk, being perfectly hollow, is easily dried. It is pulled out of the earth before the grain begins to form. After being freed from the soil, which adheres to the root, it is formed into small sheaves to be winnowed; the part above the last joint of the stem is then plucked off, which is from four to six inches long, the ear remaining attached to it. This being done, it is bleached alternately by the dew and the sunshine. Rain is very injurious to it, and destroys much of its whiteness. When a sudden shower comes on, every one is in motion gathering up the straw. The lower parts of the straw are treated in the same manner, and employed in forming mats of an inferior quality. The upper parts, torn off just to the knot, are sorted according to their degree of fineness. This stapling is made with much care, and usually affords straw of three different prices. A quantity of straw worth three quarters of a paoli (4½*d.*) after having undergone this process is sold for ten paoli (4*s.* 7*d.*) The tress is formed of seven or nine straws, which are begun at the lower end, and are consumed, in plaiting, to within an inch and a half of the upper extremity including the ear. All the ends of the straws that have been consumed are left out, so that the ears shall be on the other side of the tress. As fast as it is worked it is rolled on a cylinder of wood. When it is finished, the projecting ends and ears are cut off; it is then passed with force between the hand and a piece of wood, cut with a sharp edge to press and polish it. The tresses, thus prepared, are used so that a complete hat shall be formed of one piece. They are sewed together with raw silk. The diameter of the hat is in general the same, the only difference consists in the degree of fineness, and, consequently, the number of turns which the tress has made in completing the hat. These hats have from twenty to eighty such turns, the number regulating the price, which varies from 20 paoli (9*s.* 2*d.*) to 100 piastres (upwards of 20*l.*) Those of the first quality have no fixed price. A hat which sells for 100 piastres affords a profit of 40 to the merchant; the straw and silk costing 20 piastres, and the labour 40 piastres. The workers gain about 3 or 5 paoli (1*s.* 4*d.* or 2*s.* 3*d.*) per day. Several mercantile houses at Florence and Leghorn buy these hats on the spots where they are worked. There is one of these houses which annually exports them to the value of 400,000 florins (3,500*l.*)

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French speculators have tried to cultivate this sort of straw, but they have not been able to obtain so fine a quality as that of Tuscany. Before bringing them to sale, the hats are once more subjected to bleaching by sulphur.—*From the French.*

IMPROVED PROCESS FOR MAKING VERMILION.

Kirkhoff first showed that by commingling and triturating mercury, sulphur, and potash together, and applying heat, cinnabar might be obtained; but the process was uncertain, and gave variable quantities of vermilion. The following is a process recommended by M. Brunner:—

300	parts of mercury.
114	. . . sulphur.
75	. . . caustic potash.
400 to 450	water.

The mercury and sulphur are first triturated together from three hours to a whole day, according to the quantities used. When the mixture is homogeneous the solution of potash is added, the trituration continued, and the mixture heated in an earthen vessel or porcelain, or, if on a large scale, of iron. At first, the stirring must be constant, afterwards from time to time. The heat should be sustained at 113°; it should never pass 122°. The liquid should not be allowed to diminish by evaporation, but be made up. After some hours the mixture will acquire a reddish brown colour, and then great care is required; the mixture must not pass 113°. If it becomes gelatinous, a little water should be added; the mixture of sulphur and mercury should always be in a pulverant form in the liquid. The colour becomes more and more brilliant, and at times increases with astonishing rapidity; when it has attained its highest intensity the vessel is to be taken off the fire, but still to be retained warm for several hours. The time necessary for the application of heat appears to be directly as the quantity operated upon. If the proportion above be in grammes (about 15½ grains each), the red colour will appear in about eight hours, and the operation be finished in about twelve hours.

The cinnabar is then to be washed, and the small quantity of metallic mercury that may be present separated; from 328 to 330 parts of vermilion will be obtained of a colour equalling that of the native cinnabar, and far surpassing that of cinnabar obtained by sublimation. The mercury and the potash should be quite pure.—*Annalen der Physik*, 1829.

STRENGTH OF WINE AND OTHER BOTTLES.

M. Collardeau has constructed a machine for the purpose of trying the strength of wine bottles. It has been presented to the Academie des Sciences, and reported upon by MM. Hachett and D'Areet. The bottle to be tried is held at the neck by means of a lever, having three branches, which grasp is below the ring; being then filled with water, it is connected by means of pipes, with a forcing pump, the pipe having a cap furnished with leather, which is firmly held down by the apparatus upon the mouth of the bottle; the pressure upon the parts here increases with the pressure of the water within the bottle. Besides the pump, levers, and connecting pipe, there is also a manometer connected with the interior of the bottle, to show the pressure exerted. When a bottle is burst in this way by the hydraulic press, no violent dispersion of its parts takes place, unless indeed, in place of being filled with water, a portion of air is left in; then when it breaks it flies to pieces, and would cause danger if exposed.

Bottles intended for the manufacture of brisk champagne or Burgundy, being tried, were found to break with a force of between twelve and fifteen atmospheres, exerted from within outwards: a few rose to eighteen atmospheres. Bottles which had contained champagne of the finest quality, broke at the same pressure. Bottles which resisted the pressure of twelve atmospheres usually broke with one or two atmospheres more, but the number of these was small. The fracture of bottles in the manufacture of brisk

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champagne is from 10 to 20 per cent.; and in certain cases, which however are rare, almost the whole have been broken. It appears quite certain, that during the fermentation of the wine, the pressure rises above twelve atmospheres; but the full extent can only be ascertained by careful experiments made by the wine proprietors.

The commissioners then remark, that the best bottles intended for brisk wines are too weak; the general fault is want of strength and uniformity in the belly of the bottle, especially at the functions with the neck and with the bottom.

As the greater number of bottles for brisk wines are of the same quality, it becomes a question why some should break and others not. This difference is supposed to depend upon the form of the neck and quality of the cork, allowing a little gas to escape in some cases and not in others. If the bottles and corks were all alike, all those which contain the same liquor at the same temperature would probably break at the same pressure. The only means of avoiding fractures is, either to make the bottles sufficiently strong, or to allow a little escape of gas by the cork. The least thickness of glass in the belly of the bottle should be 2 millimetres (079 of an inch), but generally it is only 1 millimetre at the part next to the bottom.—*Bull. Univ.* E. xiv. 80.

THE ARITHMETICAL QUESTION, P. 333.

Sir,—Your correspondent, who in your last number signs himself "No Tiro," begs the question, by assuming, that the false value is the basis, on which the calculation must be made. Surely, I have at least equal reason for considering the question, as referring to the proposition, which the difference between the two values bears to the real value, as to that which it bears to the false value.

Suppose the real value to be . . £400
The false value 100

The difference will be . . £300
that is, ¾ of the real value=75 per cent. Or
as 400:100::100:25 the false value of 100*l.* that is 75 per cent. under the real value. In other words, the goods are valued under the real worth, or are undervalued at the rate of 75*l.* on every 100*l.* In this view of the subject an article cannot be undervalued at more than 100 per cent.; and this view I consider to be more correct, than that which has been taken of it by "No Tiro." In estimating over value, we in like manner assume the real worth, as the basis of calculation, or the *datum* of reference. Consistency requires the same precedence in both cases.

ALPHA.

MINOR CORRESPONDENCE.

Cavallo on Air.—Sir, If your correspondent R. C. will address a note to me, (at your Office in Fleet-street), with his name and residence, I will with much pleasure lend him the work he inquires after, "Cavallo on Air." I believe it is now rather scarce, and am not able to inform him where he can get a copy to purchase.

Yours, &c.

Y. M.

Nutt's Bee-Hive.—Mr. Editor, In No. 341 of your Magazine you give a communication from Mr. P. Massingbird, of Gunby Park, containing a very flattering account of a method of keeping bees by Mr. Thomas Nutt; and if the general result will be only half the produce, he states, I think it will be a great benefit bestowed upon the country. Mr. Massingbird says he leaves the method to Mr. Nutt to explain. Will you be so good as through your Magazine to request either of these gentlemen to state the remuneration Mr. Nutt expects for the disclosure of the management of the bees?—how he intends to give the desired information?—and if by a publication, how much the price of it, and when we may expect it published?

AN "APIARY."

[We have received a great many letters to a similar effect with the preceding, and hope Mr. Nutt or Mr. Massingbird will not delay furnishing the information so much desired.—EDIT.]

INTERIM NOTICES.

We are enabled by the publication of a double sheet this week to give our readers a full account of the conclusion of the proceedings in Chancery in the important case of Lord Cochrane and Mr. Galloway against Messrs. Braithwaite and Ericsson, and also our view of the merits of the rival inventions.

The correspondent who has favoured us with a statement of some matters of fact respecting the above case ought to authenticate it with his name.

We regret to inform "Mechanicus" that the institution respecting which he makes inquiry, did not succeed.

Mr. Brown's note came unfortunately too late.

Communications received from J. D.—Mr. Saul—A Recent Subscriber—D. E. M.—W. E. (Sunderland)—W. E. (London).

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Mechanics' Magazine,

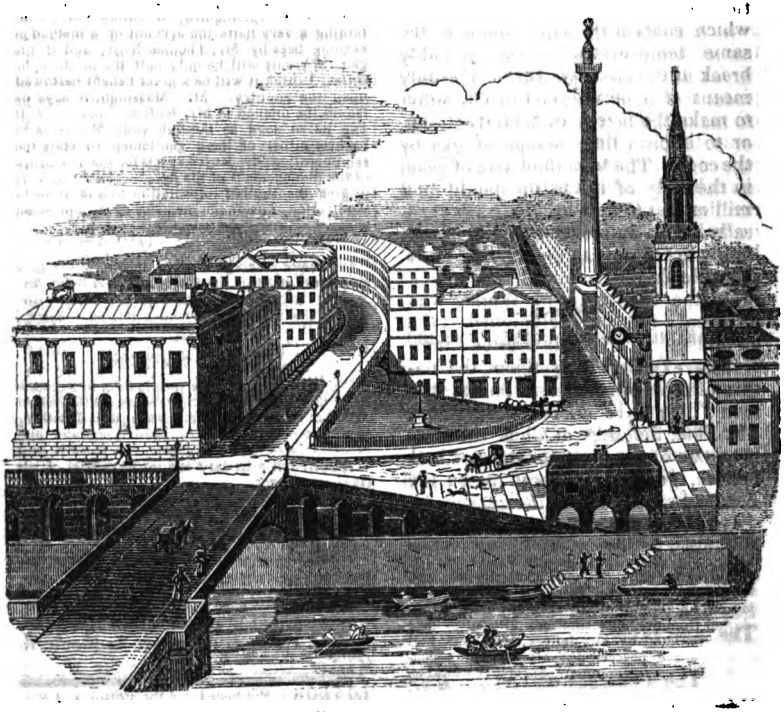
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 366.] SATURDAY, AUGUST 14, 1830. [Price 3d.

"But after all, courteous reader, I shall court you to no partiality on my side, but leave you at your liberty to judge of my performance as you would have another judge of any invention of yours. All that I desire is, that the world would act honestly and on the square with me."—CAPT. SAVERY.

"To acquiesce in the spoliation of others, is to sow the seeds of a harvest of injustice and suffering for yourself."—SOUTH.

JEFFERY'S PLAN OF APPROACHES TO LONDON BRIDGE.



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DESCRIPTIVE ACCOUNT OF THE PRINCIPAL BRIDGES ERECTED OVER THE RIVER THAMES. BY MR. C. DAVY, ARCHITECT.

No. XVII.

Approaches to New London Bridge—Arch over Thames-street.

The most remarkable feature in the case of the approaches to New London Bridge, was the apparent ignorance displayed of any thing like a grand entrance being required. It was even hinted that a little alteration of Fish-street-hill would alone remedy every inconvenience. Public attention was, however, at last aroused by the appearance of certain pamphlets, and anonymous letters in the newspapers, recommending the works to be stayed until the line of the new approaches was finally arranged, and recommending, each in their turn, plans for this purpose, but having generally for their object the prevention of those obstructions complained of for the last fifty years. These plans, it may be well conceived, were of various degrees of merit; at the same time, arising as they did from proper feeling and a knowledge of the available opportunities offered by the erection of the new bridge to effect so desirable an improvement, they were highly acceptable to the public. It is probable they were not quite so much so to the Committee of Works, who must have naturally felt piqued at the circumstance of uninterested individuals explaining to them the nature of their own duties. Among the many that have offered suggestions, Mr. Peter Jeffery,* of Cheapside, has been one of the most active, and is, I believe, generally allowed to be the projector of the Thames-street Arch. This has been disputed, and in justice to all parties, the state of the fact should be here noticed.

In *The Eclipse* evening paper of the 22d of November, 1824, a letter appeared, signed "A Citizen," suggesting, with very slight deviation, the plan proposed by Mr. Jeffery, which, it seems, did not appear before the 9th of February, 1826; and as Mr. Jeffery had in his plan extended his improvements *north* of Cornhill, another advocate for the *original idea* appeared in the person of a Mr. Fortune, who, in a paper war that took place between the parties, asserted, that the former gentleman had adopted *his* plan. The plan (be it remarked) proposed by "A Citizen" (Dr. Price) was for a street *south* of Cornhill. Another writer and projector, Mr. George Allen, architect, says, "that the plan of Mr. Jeffery was brought into notice by a letter from Dr. Price, of Cannon-street." It is also said, that these statements have not been contradicted, and that the only merit Mr. Jeffery can claim is the mere preparation of a drawing made from the previous ideas of other parties. For the credit of all, I sincerely hope that the matter (which is not so trifling as many imagine) may be cleared up, and that to whomsoever the credit belongs of this the most favoured plan, he will have his well-earned share of approbation for the public benefit he has conferred. The Bridge Committee themselves have certainly had little, if any, share in the arrangements hitherto proposed, and for the principal part ultimately adopted.

According to the latest account, the plan for the approaches at present stands as follows. First, as to the City side. The principal street, measuring the full width of the bridge, will, by means of an arch thrown across Thames-street, proceed in a slanting line towards the upper part of Grace-church-street, a little above Leadenhall Market, which it leaves to the right; the main road thence continuing from the intersection of Cornhill and to Bishopsgate-street, as before. The cross-way of Thames-street will run under the Thames-street Arch, by

* In a recent police report, Mr. Jeffery and Mr. Knight, the Clerk of the Works, have been rather conspicuous. Mr. Jeffery was engaged in measuring the arch, &c. over Thames-street, and was forcibly withheld from so doing by Mr. Knight, on account of the work not being finished, and from misrepresentations alleged to have been circulated by Mr. Jeffery, who says that even now the proceedings are not being conducted in a proper manner. Surely, it would be more decorous for the parties to give and receive suggestions with a kindlier feeling. Much good has been done through this spirit of liberality, and many useful suggestions derived from parties who have received no fee or reward, save the pleasure of aiding in the perfection of this noble work.

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which means the dangerous cross-carriage at that place will be wholly avoided: two short semicircular streets, the one commencing about the middle of St. Martin's-lane, and the other near that of Love-lane, in Upper and Lower Thames-streets, will give access from those parts to the great new street on each side of Fish-street-hill, a little above the Monument. The sketch accompanying this paper is from a vignette attached to the plan proposed by Mr. Jeffery, and bears the date of March 16, 1827. I think, however, that it requires some explanation, for another plan by the same gentleman (a copy of which I have before me), and bearing the *same date*, exhibits a different arrangement altogether. I may farther add, that the present *executed* plan of the stairs to the new bridge, will make some difference as regards the façade of the embankment on the City side. If proof were wanting, what I have here touched upon is sufficient to show, that instead of the late Mr. Rennie's design being the *ne plus ultra* of those that were exhibited in competition, it has been absolutely squeezed into a position totally unfit for it, and one, I verily believe, for which it never was designed.

(To be continued.)

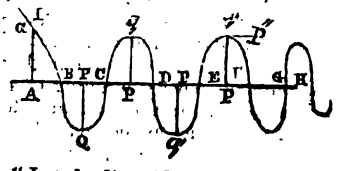
PHYSICAL ESSAYS.

No. 4.

On the Attraction of Cohesion.

(Continued from p. 271.)

"The nature of cohesion," says Dr. Thompson, "has been more happily explained by Boscovich than by any other philosopher. Indeed, it forms the most beautiful and satisfactory part of his theory. According to him, the particles of bodies cohere together when they are placed in the limit of attraction and repulsion."



"Let the line AH represent the insensible distance between two particles; and let the ordinates of the curve I*Qq'q''* represent the attracting and repelling forces of the two particles, as the second moves along the line AB, while the first remains in the point A. The ordinates of the curves situated above the line AH represent repulsive forces, and those below the line represent attractive forces. The points B, C, D, E, F, G, H, where the curve cuts the axis, represent the limits between attraction and repulsion. While the second particle is in any part of the line AB it is repelled: the repulsion increases as the particle approaches A; and at the point A it is infinite, because the line A*a* is to be considered as an asymptote to the curve. At the point B, the second particle is neither repelled nor attracted. In every part of the line BC it is attracted; and the attraction is a maximum at P, because there the ordinate PQ is a maximum. At the point C it is neither attracted nor repelled. In every part of CD it is repelled; in D it is neither attracted nor repelled: in DE it is attracted; and so on. Now, the points BDF and H are called by Boscovich limits of cohesion, because particles placed in these points remain unaltered, and even resist any force which endeavours to displace them."

"Boscovich supposes, that in all cases of cohesion the particles of the cohering body are so situated as to be in these limits of cohesion with respect to each other. According to this very ingenious theory, cohesion is not, properly speaking, a force, but the interval between two forces." "What has hitherto been called the *force of cohesion*, is the attraction which prevents the cohering particles from separating from each other, and which begins to act, or, more precisely, which becomes prevalent, when the particles are urged to a greater distance from each other."

To deny the ingenuity of this theory would be unjust, but mere ingenuity is nothing unless the theory agrees with the phenomena. I have two objections to the above explanation of Boscovich, which are these:—1. Of such an alternation of attractive and repulsive forces as that imagined by Boscovich, we have no evi-

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dence. Boscovich supposes that a body is under the influence of only one force at one time, except when in the limits of cohesion. What is the proof that matter is not under the influence of calorific force? and is not this force always repulsive? I am well aware that there are many cases in which caloric loses its direct or thermo-repulsive force, but there is always a great, indefinite quantity of "free" caloric, possessing thermometric tension, and therefore operating repulsively upon every particle of matter. 2. In the Boscovichian system the limits of cohesion, in which "in all cases of cohesion the particles of the cohering body are situated," are mere points. Now, when a body is expanded by heat, or extended mechanically, the atoms are removed from the points they at first occupied: before they can pass into others they must pass over lines of attraction or repulsion (*e. g.* BC, in which attraction alone acts, or CD in which repulsion is the active force), and during these passages cohesion ought to cease. Knowing the fact to be otherwise, we cannot regard the theory as tenable.

Arguments against a distinct attraction of cohesion have been advanced by Adams in his "Lectures on Natural Philosophy."* Mr. Adams wishes to prove that "fire" (by which he means caloric, and which he considers to be material) is the sole agent in all cases of cohesion, and the direct cause of the phenomenon.

"Fire acting below a certain degree, consolidates water into ice; if it acts above that degree, it keeps it fluid; if to a higher degree, a total separation of the parts ensues, the effects being answerable in every instance to the activity and condition of a *material* agent. When you see the effects vary, as often as there is any change in the element of fire, you are compelled by all the rules of *reason* and *philosophy* (?) to understand this element as the immediate cause of those effects, and must receive it as such till it is demonstrated to be inadequate. The cohesion of bodies by the action of this fluid may be illustrated and confirmed by some parallel effects."

"You remember our experiments with the *Magdeburg hemispheres*: you know that if the air be exhausted from within, there will be an excess of pressure without, which fixes the hemispheres firmly together; admit the air, and they fall asunder. As every fluid is naturally in *equilibrio* with itself, the air, when applied to both the inner and outer surfaces, will press with equal and contrary forces, which, of course, by counteracting, destroy each other. As the entrance of the air destroys the adhesion, by restoring the equilibrium, it is plain there was not an equilibrium before; the action from within must have been weaker than the action from without: when the former of these is made equal to the latter, the cohesion ceases; it is *one and the same fluid* that on this occasion exercises the offices of *uniting* and *separating* the hemispheres."

"Let us now pass from the surfaces of the brass hemispheres, to the cohesion of brass: this, when thrown into the furnace, soon grows red, and as the heat increases, becomes in a manner transparent: the matter of fire penetrates into the body of the metal, and when the medium within is nearly in the same condition as the medium without, there is an end of its cohesion."

"An effect which is thus made to cease in a mechanical way, may be produced in the same way; and if the entrance and extrication of the fire dissolves and separates the parts of the metal, why may not the pressure of the same element be the true cause of its cohesion; the fire within combining itself at the same time with the particles of the metal so as to have less power to exert itself against this external pressure. If you deny the pressure of the air, you must have recourse to attraction or suction, or an incorporeal agency, to account for the adhesion of the hemispheres. Allow but the existence and pressure of elementary fire, the reality of which is manifested to as many of the bodily senses as air, and you need not have recourse to any of these things to account for the cohesion of the brass.

* Adams' "Lectures," vol. i. pp. 233—240.

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If any experimentalist can exhibit one single, solitary instance of a cohering body, where he can prove the internal and external pressures to be equal in all respects, we will grant him in this case his attraction, and confess that this effect is not brought to pass in a *physical* way.

"If the changes of the atmosphere are found to make the heights of the barometer vary, who can doubt that *the pressure of the air* is the sole and adequate cause of its suspension? Thus, also, if the degrees of density in a cohering body vary with the degree of heat, where should we seek but in the *element of fire* for the true and physical cause of cohesion?"

The influence of caloric in many cases of cohesion cannot be denied: it is often very considerable, and that, not only in those cases in which a change of state is effected, but when the body retains its first form. Not only does an increase of temperature diminish cohesive attraction by inducing incipient liquefaction, as is the case with regard to resins, wax, some metals, glass, &c., but a reduction of temperature produces the same effect by causing an extreme brittleness. "Extreme cold will harden and render them (metals) so brittle, that large bars of iron may easily be snapt asunder, after they have been exposed all night in the open air to a severe frost."*

From the above extracts it will be seen that Mr. Adams wishes to prove that "fire" is the "immediate *cause*" not only of the variations in the cohesive force, but of the force itself, and says, that "a power of so fluctuating a nature can be no property of the cohering matter." In drawing this conclusion, Mr. Adams assumes that a physical effect is produced by only one physical, instrumental cause.

So far from this assumption being true, it may be questioned whether any physical effect whatever is produced by one single cause. But however the general question may stand, nothing is easier than to show that Mr. Adams has grounded his inference upon a principle which in this particular case is decidedly erroneous. A parallel case will make this abundantly evident. Suppose a heavy cart to roll down a hill by its own weight. A man might stand before it, might push against it, and by exerting different degrees of force alter the rate of the motion, or even arrest the progress of the cart. In this case all the variations in the velocity of the cart are direct effects of the man's opposing force, but the motion itself is produced by another and perfectly distinct cause.

Now, if we suppose the particles of caloric to possess idio-repulsive power, and by the exertion of that power to cause expansion (which suppositions are made by Adams), it cannot be supposed that this power operates as a contractile force.

In order to disprove the alleged parallelism between the *modi operandi* of the atmosphere and caloric, I would farther observe, that it is a necessary and indispensable condition in all cases of unequal atmospheric pressures that there be no passage for the air between the two surfaces. On this account the plates of the air-pump, the rims of the hemispheres, &c., are finely ground. The more subtle and penetrating the fluid is, the more close must be the contact of the surfaces. Now, so far from there being any contiguity of surface in the case selected by Adams, it is indisputable that after certain increments of temperature there is a separation of the atoms of the brass; so that even if we were to grant that the atoms were *at first* in close contact (though this would not save Mr. Adams' hypothesis), yet we must allow that *afterwards* no such contact could exist.

The differences in the force of cohesion in different bodies are not only unexplained by Mr. Adams, but they present insuperable objections to his theory. Mr. Adams expressly says, that temperature is the test of pressure; consequently, at the same temperature all the differences in the cohesion of different bodies must be owing to differences in the extent of surface. But since caloric acts, if not upon the primary atoms of a body, yet upon particles too minute to be objects of vision, we cannot suppose

* Adams' "Lectures on Nat. Phil." i. 238.

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any differences in their surfaces adequate to the production of the above effects. Or, even if the possibility of this were admitted, where is the evidence that the superficies of the stronger cohering bodies is greater than that of others having weaker cohesive powers. Again: if temperature is the test of pressure, and cohesion, which is the effect of pressure, (according to Mr. Adams) is diminished by elevations of temperature, how is it that some bodies cohere more strongly at high than at low temperatures? Objections might also be drawn from the cohesion of alloys and other compounds; but the preceding will, I hope, convince the reader that Mr. Adams' mechanical igneous pressure does not meet and explain a single phenomenon.

I have already commented on the impropriety of giving to cohesive attraction the distinctive name of *homogeneous*.* The following cases will make this impropriety still more apparent. Acacia gum in a state of dry powder possesses no more cohesion than the generality of powders: the addition of a certain quantity of water produces a thick and strongly adhesive paste. Similar effects are produced by mixing resins with alcohol. In these cases there is a partial solution, to which perhaps the cohesion is owing. Alumina, and those clays of which it is the basis, become strongly cohesive by the addition of water. Moistened gluten possesses great tenacity. Crystallized salts cohere powerfully: the anhydrous salt is generally a powder. The adhesion of glue and resins to wood, of soft, resinous, pasty or mucilaginous substances to almost every thing that touches them, and the cohesion of lutes and cements, are cases of the same kind. The consideration of these facts, and others which will readily occur to the mind of the reader, will guard him against the opinion that cohesion is exerted only between homogeneous particles.

In many cases this heterogeneous cohesion appears to be elective. Alcohol cannot be substituted for water in the crystallization of salts, nor water for alcohol in the development of the cohesive power of resins. Lutes and cements are confined in their operation; some unite glass, some stone, and others metals.

Various hypotheses have been advanced to account for the phenomena of cohesion. Two have been examined in this essay, and both rejected as untenable. Boscovich has invented a constitution of matter which gives ample room for the play of imagination. Notwithstanding his ingenuity, however, he seems to have failed to explain the phenomena of cohesion. Mr. Adams, in explaining the phenomena on principles directly opposed to those of Boscovich, does not appear to be more successful.

Whilst some philosophers have contended for a distinctive cohesive attraction, others have regarded it merely as a modification of gravitation. Again: some have thought the phenomena of cohesion are reducible to one common cause; others think that various causes are in operation, not merely in modifying cohesion but in producing it. The phenomena which tend to establish the existence of a distinctive attraction of cohesion are numerous: perhaps equally so are those which lead to an opposite conclusion. I cannot but think that those philosophers have erred who have made all attractions to be mere modifications of that of gravitation. We nominate the different attractions not by their essences, for of these we know nothing, but by their effects. Therefore, for the same reason that we do not confound together different phenomena, we ought not to confound those different attractions which derive their distinctive appellations from those phenomena of which they are the causes. I am, therefore, inclined to advocate a distinctive cohesive attraction, in opposition to those who would make the phenomena of cohesion to be the effects of a modified gravitation.

Shall we reduce the phenomena of cohesion to one general cause? In many cases there are forces in operation, evidently the chief causes of co-

* I have myself used this name in the course of these essays, doing so merely for the sake of convenience, and because I did not then and there wish to depart from the current phraseology, as such a departure would have required an anticipatory explanation.

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hesion, which have no existence in other phenomena. Shall we adopt the opinion that various causes are in operation? This is by far the most probable opinion of the two, yet not without its difficulties. These difficulties are met with when we inquire what are these causes? and, is cohesion a main or only a secondary phenomenon?

I do not, however, think that these difficulties arise from any inconsistency between the facts and the theory, but from a paucity of data on which to build a complete theory.

In concluding these essays I would suggest, merely as a conjecture which a farther examination of the phenomena may or may not verify, that caloric is a much more influential agent in the phenomena of cohesion than is at present generally supposed. My ideas on this subject, which I shall perhaps develope at a future time, are grounded upon a suspicion that that idio-repulsive force which the particles of caloric are generally considered to exert, is merely imaginary, and deduced from a partial view of thermosophical phenomena.

H. H.

THE ARITHMETICAL QUESTION, NO. 363.

Sir,—In your last Number, your correspondent "Alpha" states rather positively, that in my answer to the arithmetical question in No. 363, I have "begged the question." I may with truth retort, that *he* has begged the question. I showed that an article might be undervalued more than 100 per cent, which was required. This he has denied in words, but not in fact; he has endeavoured to show "*an odds without a difference*," because 75 per cent. on 400*l.* is the same as 300 per cent. on 100*l.* "Alpha" argues as if it were attempted to prove that an article could be valued at 200 per cent. less than nothing! The propounder grounds the original question on the same point, which is a mere *catch*, but he is caught in his own trap. I will here give a singular instance to the point—proving that the false value is the *real* value on which to found the calculation.

A gentleman in passing St. Paul's bought a penknife containing 8 blades for 1*s.* A friend, on hearing the price and examining it, said, "the fellow had stolen it," for that it was worth 400 per cent. more, or 5*s.* When the seller valued it at 1*s.* did he not undervalue it 400 per cent.?

I should not again have troubled you had not "Alpha" tried to raise a question out of nothing, or rather to make an important *arithmetical* question out of what I conceive to be more a logical question.

I am, Sir,
Yours, &c.
No TYRO.

Maidenbury, Aug. 11, 1830.

THE MARQUIS OF WORCESTER'S SCHEME OF PERPETUAL MOTION.

Sir,—As it has been the opinion of some of your correspondents that the subject of perpetual motion should be kept going in your pages for the sake of the good that may come of it, I have taken the liberty to trouble you once more on this head. One of your correspondents, Mr. T. Bell, some time since, promised us a scheme in which weights may descend at a greater distance from the centre or axis of motion than that in which they ascend, and yet the equilibrium be preserved in every situation of the machine; and this he considered to be the nearest approach to, if not the identical, construction of the Marquis of Worcester's invention, No. 56. Now, though this is not strictly true, unless the weights are kept so by means of a force, which tends to act on the system in the contrary direction; and which, if admitted, may be executed in a great variety of forms, even to the extent of the weights descending and ascending, both on the one side of the axis only: yet the pretensions of the Marquis in his description of this wonderful piece of ingenuity may be very simply effected; that is, they may fall out to the distance of one foot in passing the vertex of a wheel of 7 feet radius, or, as he has it, 14 feet over; and, on the con-

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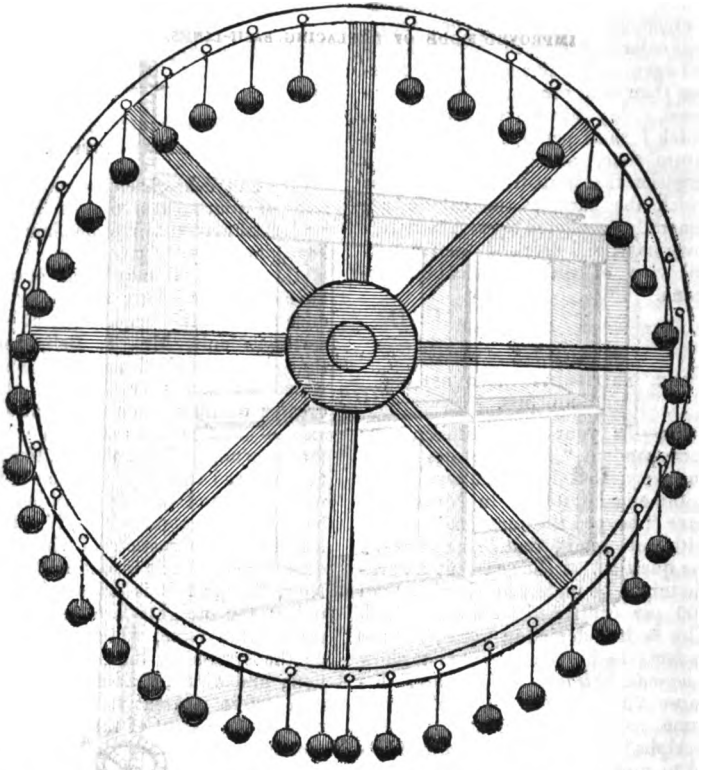
trary, they would fall in passing the vertical diameter at the bottom, or, as he has it, on the lower side move a foot nearer. As your correspondent has not thought proper to give us his plan or explanation of the Marquis's invention, I shall give you what I consider to come as near to the Marquis's plan as the words of his description can suggest to one who has travelled much farther than him in this mazy road. I have no doubt but the following drawing exhibits the principle of the Marquis's wheel. It will be observed that he particularly mentions the weights shifting their position on passing the diameter line of the upper and lower sides, meaning, as I have taken it, the vertical diameter (though the shifting may be made to take place in any part of the circumference on the opposite sides); but this circumstance most probably induced him to overlook that, though the horizontal distance was greater in the upper descending quadrant than in the lower ascending one, or opposite end of the respective diameters, still the reverse takes place in the remaining half of the wheel, and when each weight has taken its new position at the shifting point, equilibrium is preserved.



I beg leave to add, that it is not by such crude notions as this, or any other, I have seen published as expositions in support of the prejudices entertained against this subject that the question can be decided; I believe there *are* principles, could they be brought into action, which would effect the desired purpose, and the difficulty is mostly in the practical application.

Yours, &c. HEZRON.

London, July 10, 1830.

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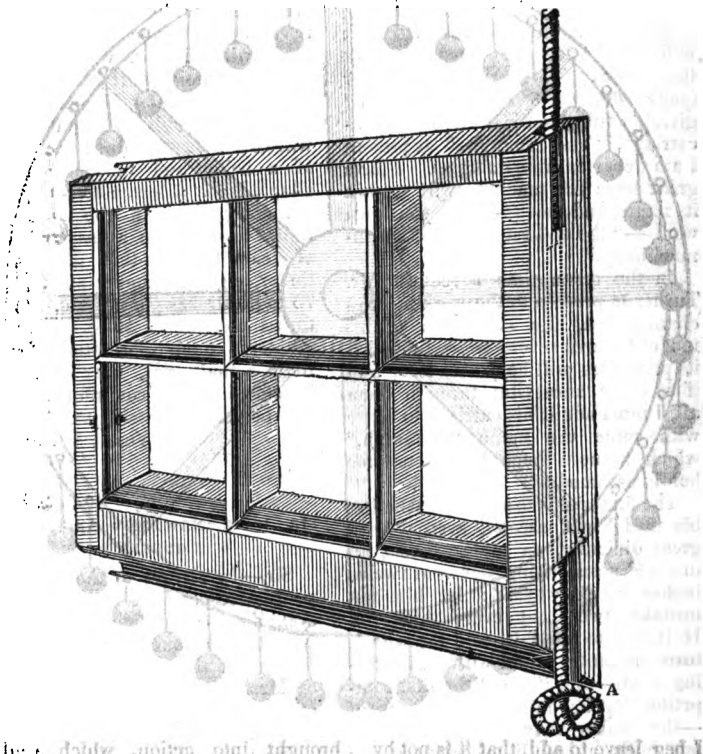
Explanation of the Engraving.

The diameter of the Marquis's wheel is 14 feet, and its circumference 44, very nearly, which, divided into 40 portions of 1 foot each, for the weights to move in, leaves 4 feet, or 48 inches, for the intervals of space to stay the weights, and allows of mortises of about 1¼ in. in diameter, as represented; the rest of the figure needs little explanation. The mode of attaching the weights may vary; but as the Marquis's words are "*they hang*," I have represented them as so doing in the grooves of the wheel on a pulley, running on the two rims of iron composing the circumference thereof; and if the weights are divided in two parts, one half being on each side the wheel, the lateral pressure thereon will be prevented. The only motion that would take place on this plan, would be a vibration to the extent of about 10 degrees of a circle, on the wheel being slightly agitated either by design or accident, unless a moving force were applied in either direction sufficient to cause it to revolve on its axis. It is probable the Marquis designed that the space the weights moved through should be chords of the arc, or a direct line, and not portions of the circumference; still this alters not the case.

IMPROVED MODE OF REPLACING SASH-LINES.



Sir,—I herewith send you a drawing of my improved mode of replacing window lines, or what is called by some the sash-cord. I consider the old plan very objectionable, as the sash is obliged to be taken out of the frame before the cord can be replaced, and in so doing the painting is injured. The object I have sought to accomplish is, not to take the sash out of the frame at all, but to make the cord pass down the style when in the frame.

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I presume it will be easily understood, from a slight inspection of the drawing, which is the lower sash out of the frame. The cord passes down the style in the same manner as on the old plan: only instead of the knot being made about the middle of the style, the cord passes down to the under edge, when a knot is made, as at A; the cord is then driven back till the knot comes to B. A piece of wire may be used, which will be found of service in replacing the cords.

I remain, Sir,
Yours respectfully,
M. Saul.

Sulyard-street, Lancaster,
July 12, 1830.

STEAM-CARRIAGES.

Sir,—Some months hence I trust it will be my pride and pleasure to meet the wishes of Mr. William Turner (page 356, No. 364), and others, by giving a full description of my steam-carriage, "The Triumph;" at present I am debarred from doing so. I have great hope the machine will sustain its name, and prove—to use your own words—"the noblest result of steam-machinery."

In the mean time I request Mr. Turner to propose to the working mechanic, Lea, the submisson of his model to three severe trials, by which its principles will be put to test; and if it come successful through them all, I must admit his carriage to share with mine the name "Triumph," which name I hope I have not too boldly assumed.

The first trial is to ascertain whether his model will ascend, even if with great difficulty, on plain wheels, an inclined plane, rising eleven or twelve inches at every yard: let him not mistake, twelve at every thirty-six. If it fail to do this, and the wheels turn constantly round without mounting at all,—and it is not the first competitor that has failed under my proof—the maker may be assured it is not built, although on new, on the true principles of locomotion, and farther trial is needless; if it succeed in this trial, I will state the other two.

I do not say this on mere theory or speculation, but pledge my word that my smaller models have, with much hesitation and difficulty, ascended on plain wheels the great steep just named.

My larger carriage has not been so severely tried, because I know it is not constructed with sufficient steam-power in proportion to its weight to effect this hard task.

Locomotion is quite a distinct branch of mechanical science. Its principles have never, I believe, been yet distinctly treated of, and, I think, never before known. Its leading principles are few and simple, and show that locomotive machinery is not capable of effecting quite so much as living horses in some cases, and more in others.

I shall feel obliged if Mr. James, Mr. Braithwaite, or any others of your readers who have made exhausting or blowing boilers, will inform me, either privately addressed to the care of Mr. Mort, printer, Newcastle-under-Lyme, or through your columns, what will be the least weight and expense of a boiler and blowing-apparatus, adapted for a locomotive-carriage—including water in the boiler, *warranted* to maintain a *constant* supply of steam to a six-inch diameter cylinder, eighteen inches stroke, going 75 to 80 strokes per minute, at a continual pressure of 50lbs. per inch, or greater? Such information, if gained from actual trial, may perhaps be beneficial to the communicator, and will be very acceptable to,

Yours, &c.
Saxula.

SIR ISAAC NEWTON'S ARITHMETICAL QUESTION.

Sir,—In answer to the remarks of your correspondent, N. Logan, page 360, on the solutions of Sir Isaac Newton's arithmetical question, I beg to observe, that not only the solution of Mr. Latham, but also the solutions of your other correspondents, are incorrect.

Now, according to Sir Isaac Newton's formula, as stated in the question (vol. xii. page 480), we have $a = 12$, $b = 3\frac{1}{2}$, $c = 4$, $d = 21$, $e = 10$, $f = 9$, $g = 24$, and $h = 18$. Whence, according to the formula,

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$$\frac{bdfgh - aegk - bdefg + acefg}{befh - bceh}$$

We have $\frac{285768 - 207360 - 63504 + 103680}{5670 - 2520} = \frac{118584}{3150} = 37, \frac{1}{1}\frac{0}{1}\frac{1}{5}\frac{4}{0}$.

Now, by increasing the numerator and denominator of the fraction $\frac{1}{1}\frac{0}{1}\frac{1}{5}\frac{4}{0}$ by its 1-9th part, we obtain $\frac{1}{1}\frac{2}{5}\frac{6}{0}\frac{8}{0}$, or $37\frac{2}{3}\frac{4}{5}\frac{8}{0}$ oxen, which is precisely the same number as I obtained in my solution, dated March 4, 1830.

Hence it is evidently *incontrovertible* that Sir Isaac intended the computation to be founded on the *uniform growth* of the grass in each case. Another proof (if one were wanting) that this eminent philosopher did not found any of his theories in opposition to the "*laws of nature!*"

Your correspondent, G. S. is also in error as to the number of the oxen fed on the grass of the after-growth. "G. S. states it at 21 3-5ths oxen," whereas, by my computation, the number will be found to be = to $24\frac{1}{3}\frac{2}{5}\frac{4}{0}$.

Yours, &c.
J. UTTING.

Lynn Regis, August 2, 1830.

[The following is the solution with which we were favoured by Mr. Utting. We did not insert it because we thought it erroneous; but as Mr. U. still remains satisfied of its accuracy, after having had an opportunity of comparing it with those which we preferred, we feel that we should be wanting in respect to our able and esteemed correspondent, if we did not leave the question of superiority to the judgment of our readers. We would just remark, in passing of the computation in the preceding letter of Mr. Utting's, that it seems essentially wrong in one particular; *b* is assumed as $=3\frac{1}{2}$, whereas it should be $3\frac{1}{4}$. See vol. xii. p. 360.—ED. M. M.]

MR. UTTING'S ANSWER TO THE ARITHMETICAL QUESTION, MECHANICS' MAGAZINE, VOL. XII. P. 480.

"*If* 12 *oxen eat* $3\frac{1}{2}$ *acres of pasture in four weeks, and* 21 *oxen eat* 10 *acres in nine weeks, how many oxen will eat up* 24 *acres in eighteen weeks?*"

Now, 12 oxen to $3\frac{1}{2}$ acres is $3\frac{1}{7}$* oxen to 1 acre for four weeks.

Or $13\frac{1}{7}$ oxen per acre for *one* week.

Again, 21 oxen to 10 acres is $2\frac{1}{10}$ oxen to one acre for nine weeks.

Or $18\frac{9}{10}$ oxen per acre for *one* week.

Hence 4 weeks grass gives $13\frac{1}{7}$
And 9 weeks grass gives $18\frac{9}{10}$ } oxen per acre for *one* week.

The difference $= 5\frac{1}{1}\frac{3}{0}$ oxen per acre for *one* week, or $1\frac{1}{3}\frac{3}{5}\frac{7}{0}$ oxen per acre for *five* weeks, on the grass produced *after* the oxen were first put to feed.

Now multiplying $1\frac{1}{3}\frac{3}{5}\frac{7}{0}$ by 4 we obtain the number of oxen per acre for *one* week, fed on the after grass, during the four weeks in the first case $= 4\frac{5}{3}\frac{2}{5}\frac{2}{0}$; which, subtracted from $13\frac{1}{7}$, leaves $9\frac{1}{3}\frac{2}{5}\frac{8}{0}$ oxen per acre. This divided by four weeks gives $2\frac{1}{1}\frac{1}{5}\frac{7}{0}$, which is the number of oxen per acre, the pasture would maintain for four weeks, if the grass made no farther growth after the oxen were turned into it; for $2\frac{1}{3}\frac{1}{5}\frac{7}{0} + 1\frac{1}{3}\frac{1}{5}\frac{1}{0} = 3\frac{1}{3}\frac{2}{5}\frac{8}{0} = 3\frac{1}{7}$* as above stated.

To find the number of oxen maintained on the after grass, produced in the latter part of the inquiry, viz. in eighteen weeks, we have $1\frac{1}{3}\frac{1}{5}\frac{1}{0} \times 18 = 18\frac{3}{3}\frac{4}{5}\frac{4}{0}$,

Whence the oxen maintained by the grass of the first growth $= 9\frac{1}{3}\frac{2}{5}\frac{8}{0}$
Oxen maintained by the after grass - - - - - $18\frac{3}{3}\frac{4}{5}\frac{4}{0}$

Their sum $= 28\frac{8}{3}\frac{2}{5}\frac{2}{0}$.

* The number of oxen fed on the *latter* grass being computed in *The Artizan* for 4-5ths of the time only.

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the number of oxen per acre for one week, maintained by the whole produce. Or by dividing each of the above numbers by 18 weeks, we obtain the number of oxen which *each acre* will maintain during the *whole* of the 18 weeks.

Equal to $0\frac{114}{180}$ fed by the grass produced on each acre previous to the oxen being put to pasture.

Also, $1\frac{113}{180}$ fed by the grass produced on each acre during the 18 weeks.

Sum $= 1\frac{293}{180}$ fed by the total produce of each acre.

	Oxen.	Acres.	Oxen.
Whence	$0\frac{114}{180}$	× 24 =	$12\frac{114}{180}$ fed on the first grass
and	$1\frac{113}{180}$	× 24 =	$24\frac{113}{180}$ fed on the after grass
Sum	$1\frac{293}{180}$	+ 24 =	$37\frac{114}{180}$ fed on the total produce.

Whence $37\frac{114}{180}$ is the number of the oxen required.

Sir Isaac Newton's formula gives the same result, but does not give the number of oxen fed on the after grass distinct from those fed on that of the first growth, which, in the above case, is very nearly in the ratio of two to one.

I am, Sir,

Yours, &c.

J. UTTING.

Lynn Regis, March 4, 1830.

P.S.—Having never seen Sir Isaac's *Universal Arithmetic*, I am unacquainted with his method of solution, otherwise than by the formula as given by your correspondent, H. T.; but I trust, if he reads the above with a little attention, he will understand the solution which I have given. The only answer to a similar question which I have seen, is given in *The Artisan*, vol. ii. page 96, printed for William Cole, 10, Newgate-street, about four or five years since, and which work was discontinued during the publication of the second volume. The solution there given is, however, totally different from mine, and is, moreover, not complete, as the number of oxen fed on the first grass is 12, and the number fed on the after growth, during the 25 years, is 30, or 42 for the number of oxen fed on the total produce, or 20 weeks, which maintain 24 oxen. The other portion of the oxen are those fed on the first grass, together with 6 weeks of the after growth, which together maintains 18 oxen, and the number fed by the total produce = 42. It is hardly necessary for me to state, that the numbers given in the question here alluded to are different from those given by Sir Isaac Newton. This seems to be considered as rather an intricate question, as the editor of the above work says he received several solutions, but only one that was correct.

STEAM-PLOUGHS.

(From the Gardeners' Magazine.)

We noticed, some time ago, the spirited offer of Mr. Handley, of 100 guineas, for the best steam-plough. We hope the time is not far distant when a sufficient number of subscribers may be found, at all manner of sums, from 1*l.* upwards, to produce 1000*l.* for the laudable and patriotic object proposed by Mr. Handley. In the mean time, this gentleman's offer has stimulated two very ingenious mechanics, Messrs. Wykes and Phillips, Market-street, Edgware-road, to produce the model of a ploughing, or, more properly, a digging or grubbing-machine, to be impelled by steam. The model is well worth examining. It is arranged on the principle of rendering the action of grubbing the fulcrum for moving forward the machine; so that, a certain power of steam being applied, the machine would move along a ridge, or a breadth of such a number of feet as might be determined on (say 6, 10, 12, or 15 ft.), at a greater or less rate, according to the tenacity of the soil. Such a machine would, no doubt, be applicable to many of the purposes of field culture, and more especially to the working of fallows. But it would not answer for ploughing up leys, or recent or tender grass-lands to be sown after once plough-

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ing; neither would it plough in manure, nor form lands into drills for turnips or potatoes; nor would it harrow, hoe, or mow, or reap, all which might be done by steam, as before observed.

To apply steam successfully to agriculture, it has always appeared to us that the engineer ought not to seek for a new implement, but simply for a convenient locomotive power for impelling the implements already in use, modified so as to suit the new impelling power. The power for dragging forward Lambert's mole-plough (*Encyc. of Agr.* § 2523) supplies the germ of this idea. There would be no difficulty in inventing a locomotive-engine that would move itself any where, either on rough or smooth, level or sloping surfaces. There would be no difficulty of stopping this machine at any one point, throwing out or down long levers, with claws at the extremities, to serve as grappling-irons to retain it firmly in its position. There might then be a vertical gin-wheel, with a chain, say of 100 yards. Supposing the locomotive-machine taken to the first ridge of a field, the chain wound up, and the end of it attached either to one or many ploughs, harrows, or other implements. Then let the machine be put in motion, and advance 90 yards, unwinding the chain, which will now lie on the ground in a line between the steam-machine and the plough or harrow-machine. Now reverse the turning of the gin-wheel, and the plough will be dragged up to the engine. Change the wheel, lift up or draw in (all, of course, by the machine itself) the grappling-levers, and proceed as before. To some this may seem, at first sight, a slow and awkward mode; but, if a ridge of 12 feet were ploughed, or the width of three ridges harrowed, every time the machine advanced, a 20-acre field would soon be got over. Nothing could be easier than to adapt ploughs and all implements, even Bell's reaping-machine, the thrashing-machine, &c. to such a locomotive power. Whenever an ample reward is offered, the thing will be done. Or whoever thinks fit to employ such an engineer as Brunell, will have the locomotive power invented and executed in a month, as a matter of course. If this mode is not adopted, stationary engines, at the ends of the ridges, must be resorted to; or fixed points, found or placed there, to which an engine and plough, attached by a chain, might plough itself forward. We recommend the subject to the "Mechanics' Magazine." It must never be forgotten that, independently of the saving of horses and their food, the farmer would never be obliged to work his soil but when it was in a proper condition for that purpose. This, in our opinion, is one of the principal arguments in favour of the application of steam to agriculture.—*Cond.*

[We have much pleasure in seconding our esteemed contemporary's recommendation of this subject to the attention of the readers of the "Mechanics' Magazine;" but at the same time we must frankly confess we scarcely entertain a hope of ever seeing steam *economically* applied to the plough. That a plough could be constructed to work by steam, we make no doubt; but that it could be made to work as cleverly or as cheaply by steam as by horse-power we doubt altogether. *Mais nous verrons.* We shall be most happy to find ourselves in the wrong. Mr. Loudon observes in another part of the last Number of his Magazine, when speaking of Messrs. Braithwaite and Ericsson's boiler:—"This is the machine that, *properly applied*, will, at some future time, plough and sow 1000 acres in a week, and reap the crop in a day!" We have, as our readers are aware, a very high opinion of this boiler, but Mr. Loudon outstrips us prodigiously in his anticipations. We may expect to hear next, of its shaving a whole regiment of hussars at a single flourish.—ED. M. M.]

THE GEOGRAPHICAL QUESTION OF AMICUS.

Sir,—I find there is an error in my solution to the question of "Amicus," as it is evident to any person that refraction elevates and causes distant objects to appear nearer than what they are in reality. The second part of the correction for refraction was inadvertently applied with an *affirmative* instead of a *negative* sign; as it should have been applied to the latitude instead of the co-latitude. The solution will stand as follows:—

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Example.

True distance in feet *pm*		True $\angle$ *pCm*	
	$\frac{1}{12}$) 477191		$\frac{1}{12}$) 1 18 5
Decrease of distance	39766*	Refraction	— 0 6 30
Appar. distance *pm* =	437425	Appar. $\angle$ *pCm* =	1 11 35
		$\angle$ PC*p* =	23 6 52
		Co-lat. =	24 18 27
		Taken from	90 0 0

Gives the latitude of the mountain = 65 41 33 as required.

Hence the above result is the same as that of your other correspondents. I am obliged to "Amicus" for pointing out the error, and trust the above will prove satisfactory.

I am, Sir,
Yours, &c.
J. UTTING.

Lyme Regis, August 2, 1830.

THE SO-TERMED CHINESE RICE PAPER.†

This article is imported into this country in considerable quantity, and is employed as a material for artificial flowers, and for other ornamental purposes. Its common name shows the popular opinion respecting its origin. The subjoined extract from a letter by John Reeves, Esq. of Canton, a member of the Society of Arts, proves, however, that the rice paper is not a manufactured article, but an unchanged vegetable production, cut spirally, and afterwards flattened by pressure.

"*Canton, March* 7, 1830.

"Sir,—My son will soon forward to you a sheet of the substance, called in England 'rice paper,' and the piece of the plant (or I should rather say, of the branch of the plant) from which it is made; but whether this is a tree or shrub I cannot at present discover, as the person from whom I had my information had only seen the mode of cutting and using the plant.

"The branches being cut into lengths of the intended, or usual breadth of the sheet of rice paper, are placed upon a thick piece of copper, with two raised edges, as guides to keep them steady; and being held in the left hand, are presented to the edge of a large knife, about ten inches long and three inches broad, made very sharp, and held in the right hand.

"A slight incision being made in the piece of branch for its whole length, it is kept moving round by the left hand, while the knife is also kept in motion by the right hand, and is thus sliced or pared down from circumference to centre, and then spread out to flatten.

"The sheets are usually made up into bundles, of nineteen or twenty pieces each, which weigh about twenty-three ounces, and are sold wholesale, for about one dollar a bundle.

"The refuse pieces, such as that sent you, are used for making artificial flowers.

"It is chiefly brought from the island of Formosa, by the Chinese junks: hence is the difficulty of ascertaining the nature of the plant; as few, if any, of the persons concerned in the sale of the prepared article at Canton, have ever seen from what it is made.

"I am, Sir,

"Yours, &c.

"J. REEVES."

* If 39766 feet, the reduction of the true to the apparent distance, be divided by 6109·77, the number of feet in one minute of a degree, &c. we shall obtain 6′ 30″, as above, &c. See note, page 335.

† From vol. xlvi. of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

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Remarks by Mr. Gill.

We have long been of opinion, from microscopic observations, that the so termed "Chinese *rice paper*," was an organized vegetable production, much resembling in its structure *the pith of elder;* and our opinion is now fully confirmed by Mr. Reeves's letter.

It appears to us, that the two raised edges upon the sides of the piece of copper, serve not only as guides to keep the pith steady, but also *to regulate the thickness of the slices;* the knife lying upon their tops, and the piece of pith being held down upon the bottom of the plate of copper, and gradually turned round and presented to the edge of the knife, whilst it is carried along backwards and forwards; the slice cut will pass underneath the knife, and escape at the front of the plate, and be succeeded in its turn by the remainder of the slice, until the operation is finished.

We have no doubt that cylindrical pieces, either of elder or other pith, might be found in this country, quite large enough to bear slicing in this manner; and which slices, after being flattened by pressure between plates (possibly warmed or heated), might serve as substitutes for those of China, and be equally capable of receiving any colours. We now see beautiful figures cut out of elder pith, by a skilful hand, exposed for sale in most of our philosophical instrument-maker's shops, for electrical experiments, and hope soon to see leaves of it formed in the same manner.

"A SERIOUS BLOW UP."

Galloway and another, v. *Braithwaite and another.*

Sir,—In the last Number of the "Register of Arts," dated August 1, 1830, I find the editor (Mr. Hebert) has, in a article under the head of "Disputed Claim of Patent-Right, Galloway and another, *v.* Braithwaite and another," thought proper to treat the subject with a degree of levity and ridicule ill suited, in my opinion, to the pages of a work professedly scientific and impartial. I repel with indignation the insinuation of *perjury* (for it is nothing less) levelled by Mr. Hebert against those gentlemen, who have been called upon, on either side, to give their professional opinions on this subject. Is it because the forms of equity require that affidavits should be filed in support of opinions, before those opinions can be received as evidence, that any person making oath that the *opinion* he has offered is a sincere one, is to be charged with swearing what is not true? Mr. Hebert states, that he uses the words "got up" *advisedly;* he might have added, without any offence to truth, *most impertinently.*

Mr. Braithwaite's "kettle," with the "furnace flue," though it has been a long while submitted to the fire and blast of Mr. Hebert—"though a little oxidized"—is not, I can assure that gentleman, so much blackened as might have been expected from the exertions of a writer of his talents and co-partner in a certain annular tubular cracker boiler. Mr. Hebert has raked out some old inventions of various dates, which he considers bear, in some degree, upon Messrs. Braithwaite and Ericsson's patent; but when it is considered, that since Messrs. Bolton and Watt first took up the steam-engine, nearly 400 patents have been obtained for generating steam, and for steam engines, it will not seem surprising, that upon a person making a discovery, it should be extremely difficult for him to steer clear, in his mechanical arrangements, of all prior inventions. Mr. H. mentions Barton's piston, and Jones's wheels, but what either of them have to do with steam-boiler, I cannot perceive. The great fact that ought to be made known to the public is, that Messrs. Braithwaite and Ericsson have invented, or as Mr. Hebert would have it, *compiled* a boiler that produces results* hitherto unequalled.

I am, Sir,

Yours, &c.

A Constant Reader,

F.

* This Mr. Hebert accidentally, no doubt, left out when remarking on the affidavits.

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PERPETUAL MOTION.

The submitter of the following proposals having, for some years, been prepossessed with an idea of being able to invent a self-moving machine, or, at least, one moved by the power of gravity, acting obliquely over the centre or axis of its motion, and having now the most sanguine hopes of success, but not the pecuniary means of carrying on his experiments, which he has hitherto done with his own hands to a great extent, on scientific principles, according with original practical ideas (arising from experience) to the best of his knowledge, exclusively his own, begs leave to submit to encouragers of ingenuity the following proposals:—He solicits a subscription of 20*l.* for which he would engage to produce 20 experimental models of machines illustrative of his ideas, differing in form and appearance, but each equally curious. In case of non-success in his attempts, the models to be presented to the London Mechanics' Institution, or disposed of as a majority of the subscribers may direct. In case of success, ample remuneration would be in his power, and the subscription returned, or a model of the successful machine furnished to each subscriber of 1*l.*

P. S.—The proposer has several ingenious ideas of inventions of a highly useful nature, which would, at all events, be greatly promoted by the experimental trials for which this subscription is solicited; and for a claim to a talent for ingenious speculation, he begs leave to refer to the Editor of the "Mechanics' Magazine," by whom, and by the Publisher of the Magazine, subscriptions will be received.

Subscriptions received.

The Editor of the "Mechanics' Magazine"	£1	1	0
A few friends of the Editor	1	1	0
T. B.	0	5	0
One of like faith . . .	0	2	6

London, July 9, 1830.

INTERIM NOTICES.

Messrs. Davis and Dickson, of 17, St. Martin's-le-Grand, request us to inform R. C. (No. 361) that they have a copy of "Cavallo on Aerostation" on sale, in excellent condition. As many of our readers may, like ourselves, have repeatedly passed through St. Martin's-le-Grand without noticing the book establishment of these gentlemen, it may be useful to mention, that behind the external display of clogs and pattens, which marks out No. 17 to the eye of the passenger, there is one of the most extensive collections of valuable works on mathematics, philosophy, and general science, ancient and modern, to be met with in London.

The gentleman who called at our office in the course of the week, and testified his anger at some article in our last Number by buying a copy and then tearing it in pieces with a "Thus—thus," seems to be read in Irish history. It is told of the rebels of 1798, that in order to evince their detestation of certain loyalist bankers, they collected all the small notes of the firm they could procure and burnt them! Even so would our unknown friend act by us! We beg to tender him our best thanks, and to acquaint him that as our sheets are all stereotyped, we can supply him with any number of copies he pleases for the indulgence of his odd whim. Only give us an hour's notice.

We have already declined to insert one testimony respecting the engine exhibited at Mr. Galloway's, because it was anonymous; and must reject "Adze's" for the same reason. While there is a question at law in dependence respecting the engine, it would be very unfair to give publicity to any thing that might affect that question, except on responsible authority.

S. Y. must just take his own way. We have asked him to favour us with a sufficient reason for inflicting on our readers a second engraving of a figure, about which nobody, as it appears to us, can be under any misapprehension; and the only reason he gives is, that he conceives "the writer of a paper is the best judge of what sort of engravings are needed for its explanation." We do not deny that the writer is the best judge, and have never been niggard in our endeavours to attend to the wishes of our correspondents in this respect: but when we find a writer requiring that an engraving shall be repeated—at some sacrifice of valuable space—(we say nothing of the expense) merely because it happened, through inadvertency, to be done on a half inch instead of a whole inch scale—we feel that we should be wanting in duty to our subscribers and ourselves were we to yield compliance with so unreasonable a demand.

Communications received from W. K.—Mr. Baddeley—N. S. D.—Neutral—Mr. H. W. Neville—Y. A.—A Sincere Friend—No Go—An Herbalist.

Errata.—Vol. xiii. p. 253, col. 1, line 13, for 3·14159259259 read 3·14159259259.

Page 335, col. 1, line 10, for P*m* read *pm*.

——— ——— ——— 11, for PC*m* read *pCm*.

——— col. 2, line 6, for P*m* read *pm*.

Page 351, Question 2, for "any rectilineal given" read rectilineal *triangle* given.

Page 356, for the upper *d* in the *figure* read *b*.

Col. 1, line 12 from bottom, for "the discharge *of* a maximum," read "the discharge a maximum."

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M. SALMON, Printer, Fleet Street.

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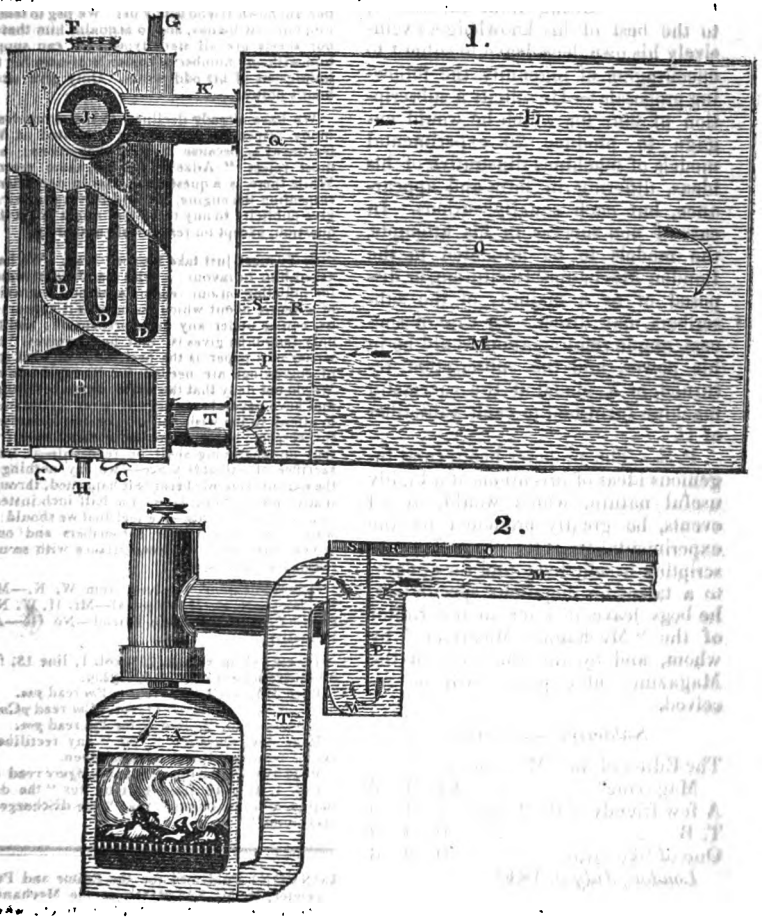
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 367.] SATURDAY, AUGUST 21, 1830. [Price 3*d*.

MESSRS. BRAITHWAITE AND ERICSSON'S IMPROVED METHOD OF MANUFACTURING SALT.



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MESSRS. BRAITHWAITE AND ERICSSON'S IMPROVED METHOD OF MANUFACTURING SALT.

The peculiar features of this improved method of manufacturing salt, for which Messrs. Braithwaite and Ericsson have recently taken out a patent, are thus described in their specification:—

"We do hereby declare the nature of our said invention to consist in heating the brine from which salt, of any required quality, is to be manufactured in a close boiler to a degree of temperature *above* that necessary to produce the same quality of crystallization by the ordinary method; and also while the said brine is under pressure in such manner as to prevent any crystallization or precipitation of salt in the boiler in which it is so heated; and thence running it into large open shallow vats or vessels, which we call evaporators, elevated above the boiler, and not acted upon by the fire—where the aqueous particles being allowed to evaporate, and the brine becoming of a lower temperature than that in the boiler, the salt crystallizes and precipitates to the bottom of the vat: by which improved method of manufacturing salt, we prevent the formation of what is usually called pan-scratch, or pan-crust, and effect an important saving in fuel."

Fig. 1 is a plan of an apparatus on this construction; A is a boiler, with parts represented as broken away, the better to show its interior arrangement; B represents the fire-bars; CC, the furnace-doors; DDDD, the flue, with cleansing doors, through which, to clean it out; F is a man hole; G is the end of the flue which goes into the chimney; H is a supply pipe to feed the boiler with cold brine; I is a cylinder fitted on to the top of the boiler for purposes afterwards explained; J is a driving pulley, which turns a shaft or spindle, working within the cylinder, which spindle carries on its lower end four vanes, or fans; K, a conduit-pipe, through which the heated brine from the boiler, after having been brought into the cylinder I, runs into LM, which is a large shallow vat or vessel, called the evaporator; with a longitudinal division at O, and a transverse one at P, the use of which divisions will be presently explained more particularly. At Q,R, and S, there are float-boards to limit the evaporating surface of the brine in the evaporator; T is a pipe serving to connect the evaporator with the boiler, and leading from the evaporator to the bottom of the boiler.

Fig. 2 is a section of this pipe T, as also of the boiler, and of the side M of the evaporator, showing the course which the brine is compelled to take under the transverse division P. The object of this division, and of the well W, is to prevent the salt, which is forming in the evaporator, from being carried into the boiler.

The mode of operating with the apparatus is as follows:—Being filled with brine, as shown in the drawing, and a fire being lighted in the furnace, the column of brine in the cylinder I will keep the brine in the boiler constantly under pressure, and thus it may be always heated to a temperature higher than that in the evaporator, while the boiler being completely filled no evaporation can take place therein, and consequently no salt will be formed there to become pan-scratch, or pan-crust. When the brine in the boiler begins to heat, the fans of the spindle within the cylinder must be turned by means of the pulley J and a driving strap, when a portion of brine will be displaced, which will pass through the pipe K into the evaporator; and the quantity so displaced being replaced by a portion out of the boiler, a corresponding portion will flow from the evaporator into the boiler, through the pipe T; and thus a constant circulation of brine will be kept up, which, as soon as it flows beyond the float-board Q, where evaporation first takes place, will begin to deposit salt, which may be raked up in the ordinary way. As the quantity of brine in the apparatus diminishes by evaporation, cold brine is to be admitted to the boiler through the feed pipe H. It is only necessary farther to observe, that the temperature required for the particular quality of salt to be produced, must be regulated by the extent of evaporating surface exposed in the vat, or evaporator.

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What Messrs. Braithwaite and Ericsson particularly claim as their invention is, "the manufacturing of those qualities of salt, the variety of which depends upon the temperature at which the crystal is formed, by heating brine in a close boiler, under pressure, to a degree of heat above that which would be required to form the same quality of salt by the ordinary method: and then causing such brine so heated, as aforesaid, to pass from the close boiler into an open vessel for the purpose of evaporation, at a distance from, and not acted upon by the fire, where the required temperature is obtained; and thence, when too much cooled to deposit salt of the quality required, returning it into the boiler to be again heated to its former temperature, and again passed into the open vessel: thus keeping up a constant circulation of brine through the close boiler and open vessel, and a constant deposit of salt."

The expense of manufacturing salt will be reduced, we understand, by this process, at least one-half.

OBSERVATIONS ON SHOOTING APPARATUS;

With Directions by which every Sportsman or his Servant may, with very little Expense or Trouble, make a new sort of Charges or Cartridges, on a safe and simple Principle. By MR. J. JENOUR, *Inventor of Eley's Patent Wire Cartridge, and Author of "An Essay on the Spiral Cartridge," rewarded by the Society of Arts.*

Though much has been written and the most contradictory notions have prevailed on the present subject, it appears reducible to a few simple facts.

The sportsman's principal object is to combine safety to himself and others, with every possible convenience and quickness of loading, and the utmost possible effect of his gun, that is to say, *to make nearly sure of any single head of game (without being liable to mangle it), at any point between the nearest and the greatest distance practicable.* In this view (admitting the gun to be of the best materials and workmanship), the subjects for consideration appear to be—1. Size of the bore. 2. Deviation from a cylinder. 3. Length of barrel. 4. Size of shot and proportions of charge. 5. Wadding. 6. Leading and foulness of barrel. 7. Clubbing or balling either with loose shot or cartridges of different sorts. 8. The spread or disc of the shot, by different ways of loading, &c.

First, as to the size of the bore. Guns of small bore shoot sharper, or, in other words, throw their shot stronger than those of large calibre, proportionably; thus, we may take as a maximum, the difference of a 16-guage light gun with an ounce and half of No. 6 shot, and a duck-gun with a bore about the size of a half-crown piece, carrying a pound of No. 1 shot: in which case, the light gun would perform as well, or better, for a single bird at 40 or 50 yards distance, than the other would at 100 yards; the advantage of very large bored guns being confined to firing at numbers of fowl together. Hence we may conclude, that the smaller the bore the better, so that it will carry a sufficient charge of shot without too much recoil; but a small calibre leads and gets foul much sooner, and is more liable to ball than a large one, in the common way of loading: objections, however, which are entirely obviated by the new charges here recommended, which the writer considers as a peculiar advantage.

Secondly. Whether there should be any deviation from a cylinder is still doubtful in some respects, though the majority of gun-makers and others have approved of the slightest possible, and a very gradual enlargement from about the middle of the barrel to the breech, and a similar one from the middle to the muzzle, liable to some little variation, according to different opinions as to the part most proper for the contraction thus occasioned, and to the exact degree of opening or relief; but as this variation from the true cylinder is in general scarcely perceptible, and as there are many who prefer the cylinder, we may safely conclude the difference to be of not much importance in respect of the average shooting of the gun; for so infinitely varied are the results

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of trials at a mark with even the same gun and the same charge, that it seems almost impossible to arrive at any accurate conclusions as to the difference in this or that system of boring, &c. But, in regard to safety, it is obvious, that should the contraction be too great it might occasion a liability of bursting the barrel, and that any kind of opening in the lower part is also more liable to occasion the same accident than a cylinder, because either a wadding or a cartridge after passing the tighter part cannot be so secure of fitting close when down, as if it had not to pass through any smaller part than where it is to remain: for, if it would expand by ramming well, even that trifling operation might happen to be omitted in the hurry of sport.

Thirdly. Length of barrel unquestionably increases the range of the shot, but in so trifling a degree from a barrel of two feet to one of three or four feet, that, after all, it seems a mere matter of choice, and principally relates to the proportionable appearance of the gun: as to any length between the two extremes, length of barrel may perhaps afford some little advantage to a slow shooter, but for the modern great quickness of action it must prove rather disadvantageous than otherwise.

Fourthly. With respect to the size of shot, the writer, having plucked and examined many pigeons killed at measured distances, and made a table of particulars, can confidently say, that No. 8 has (and of course will) with the wire-cartridge, in many instances, broken the thick bone of the wing and leg, or gone entirely through the thickest part of the body at 55 yards; and is thence led to conclude, that No. 8 is sufficient for any game with equal measures of powder and shot, the shot being made into the cartridges that will be presently described: but No. 6, which seems to be generally adopted, cannot perhaps be improved upon. As to the proportions, equal measures may be considered as the proper standard, and any material deviations therefrom as merely fanciful; the measure being regulated by the recoil, so that it is just felt without being disagreeably sharp.

Fifthly. Of wadding there is so great a variety as to puzzle the choice by the various recommendations: the common mill-board, however, certainly, answers every purpose wadding can effect as to the shooting of a gun; but if any other sort does, as stated, either keep the charge more securely in its place, or prevent the leading and fouling of the barrel, it must be a very great advantage with loose shot: but as the cartridges to be described here effect every thing possibly required in these respects, the writer considers it needless to add any thing under this head.

Sixthly. The fouling of the barrel is perhaps one of the most important considerations belonging to shooting; it must obviously alter the form of the bore, and is altogether highly disadvantageous and dangerous. It, therefore, appears a most desirable object to load in a manner to do away with leading and fouling altogether, if practicable, by any convenient means calculated for general adoption and utility. This is the writer's object in the new cartridge, the stated merits of which, as it may be so easily tried, will probably be speedily either generally known and acknowledged, or disproved.

Seventhly. Clubbing or balling is supposed by many to occur only with cartridges, but this is a most dangerous mistake; and those who consider that they may fire confidently without any regard to the position of their friends at any considerable distance with loose shot are in danger—certainly a very remote one we may say—but still they are in such of finding out their mistake by some irreparable accident: for all guns are liable to club or cluster (which latter is the most likely to do mischief, as it is similar to firing several bullets or slugs), and if but very rarely, still the bare possibility of the circumstance must leave something of an unsatisfactory feeling in the mind; so that the writer, under these impressions, considers that he shall render a public service if his new plan becomes generally adopted, and therefore trusts it will have a full and fair trial.

Eighthly. The spread, disc, or circular

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space covered by the shot, at any given distance, is, perhaps, on an average, not materially different beyond thirty or forty yards, either with different guns or charges (except when a very large or very small proportion of power is used); nor even with the wire cartridge, as regards that circumference which takes in the greater portion of the charge, merely excluding a few very wide straggling pellets; but there is a great difference as to the manner in which the shots are dispersed over such disc: thus, as the wire-case retards the dispersion, of course there must always be a greater number of pellets about the central part of the disc than with loose shot, or with any other cartridges that do not, by some other means, retard the dispersion. And when the common charge clubs more or less, it sometimes by gradually dispersing thus acts somewhat as a wire cartridge. But though there is not much variation in the space covered by different guns and charges, there is, as before observed, a great difference in different parts of such circle, and therefore there must, of course, be a similar variation as to the number of pellets put into a sheet of paper; but, as before noticed, not a much greater difference than occurs with the same gun and charge in different trials. These circumstances are attributable, no doubt, to the very uncertain manner in which the shots dispose themselves when separating. The penetrating force (strength, as it is termed) of the pellets also varies extremely, and no doubt the cause of many of the weak pellets with loose shot, when no substance is employed to fill the interstices, is that all those which come in contact with the barrel are nearly flattened in passing through it, by the violent compression and friction which occurs, but which dust, &c. by filling up the spaces between the pellets, completely prevents. Having thus far, and in the most concise manner he was able, stated his ideas, the result of numerous experiments, and long attention to the subject, the writer submits them with deference to those conversant with it; and now proceeds, in as few words as possible, to explain the principle of his new cartridges, and every thing requisite to enable any person to make them.

The principle of the new cartridge (or *brittle charges*, which the inventor considers a more appropriate appellation) consists in the charge of shot being held together simply by a uniform *brittle* substance occupying the interstices, instead of any sort of paper or other case or covering which all other cartridges have, and which cases by failing to rupture sufficiently for the egress of the shot, occasion thereby the circumstance of balling; an accident which cannot possibly occur with a charge or cartridge cemented together into its proper form by a brittle substance only: for the firing of the powder by acting similarly as a blow of a solid body, as *infallibly breaks the whole of such brittle substance into the smallest particles, as a violent blow of a hammer breaks a piece of glass.*

There are several other very material advantages attending this principle of forming the charge of shot ready for loading with; besides this most important one of impossibility of balling, which being set down as the first, we may add—second, facility and cheapness of making; third, exactness of sizes, being, in this respect, similar to bullets cast in one mould; so that when once the proper fit for a gun is obtained, it will always be preserved in any number of charges required; and from the solidity of conformation, will not in the least alter in form by carrying about, which all other cartridges are liable to do. Fourth, the charges of one making, or batch, like a batch of bread or biscuits, must be all the same in every respect. Fifth, roundness and strength of the pellets, and a uniform regularity of spread over the disc, that is to say, not tending so much to *clusters* as the shot in the usual way. Sixth, quickness in loading, as wadding is rendered *entirely useless* if the charges are made to fit with nicety. Seventh, a perfectly clean barrel (above the breech) for any number of shots.

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Directions for Making the Brittle Charges. Invented by MR. J. JENOUR.

According to the weight of shot to be made into charges, take a proportionate quantity of common bread flour (inferior meal of several sorts would no doubt answer, but the inventor has not tried any thing except common flour), and knead it into as stiff a paste as possible with water and a small proportion of lard or grease, but the latter is not essential, though advantageous. Having thoroughly kneaded the paste, and cut it through repeatedly with a knife to ascertain that the materials be perfectly blended, spread it out thinly on a firm table or clean floor, &c. and spreading the shot over it, mix them up together perfectly with the hands, or a smooth piece of wood (but not any thing to batter the shot) until the whole becomes perfectly well mixed, so that the shot come in contact with each other, as if not mixed with the paste, which should merely fill up the otherwise vacant spaces.

The next operation is to mould the composition close and tight into tin or other tubes of a size according to the gun they are intended for, and of a length according to the weight of the charge, which will be better ascertained by a few judicious trials than by any particular rules that could be set down. One tube (which may be a piece of gun-barrel) only may be used; in that case, the moulded charges must be put *gently* into a Dutch-oven, or on the hob of a fire-place, or any where near a fire, or in a slow oven, so that they may be slowly baked, scarcely to discolour them, but so that they become perfectly dry and hard throughout. They may then be slightly brushed over with gum-water, and when the gum is sticky, rolled in bran, pollard, or flour, which will make them fit with the utmost nicety,* and go down the gun pleasantly, and will more effectually prevent any of the lead coming in contact with the barrel.

To add more particular directions would be useless, as the principle of manufacture being clearly understood (which the writer trusts it now must be), something must always be left to the judgment and cleverness of the manufacturer.

The writer does not consider that he has in the least exaggerated the advantages stated, of which he fully satisfied himself by repeated trials last year, and would have taken a patent had not disappointments and misfortunes at length put it totally out of his power; which now induces him to give publicity to the plan rather than it should remain unknown, and in the hope of seeing it adopted, though with little prospect of any substantial benefit to himself, unless through the spontaneous liberality of gentlemen who may approve of this and the writer's other inventions, and may consider his exertions and misfortunes altogether meriting some assistance.

The writer has also invented a gun on a totally new principle, of the value of which feeling perfectly assured, he expended nearly his last pound in commencing a patent, about six months ago, but which still remains in the same state for the want of assistance to proceed. It appears almost hopeless for any private person, *without some influential sanction*,* to obtain assistance in a case of this nature (probably owing to the numerous impositions that have been practised on the public); however fair the claim, or however candid and honourable may be the intentions of the applicant.

There are, no doubt, many who conclude that any person who has invented a really good thing, may always find some opulent tradesman to join him in bringing it forward; and that he undoubtedly may do—but according to all the professional information the writer has been able to obtain, and his own unfortunate experience, it appears impossible, under the existing laws, for an inventor, *until he has obtained a patent*, to make any arrangement with a man of property, that will afford a security of equitable remuneration, or that can

* It is of great importance that a cartridge or wadding should fit *tight when down*. See Obs.

* The writer trusts this may meet the attention of gentlemen anxious to attain the utmost perfection as to *quickness and certainty of shooting*.

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prevent the latter from setting the former at defiance, and trampling upon a volume of deeds and agreements. There is, in fact, no security previous to the sealing of a patent, but in a perfect silence as to the construction or effects of the invention; therefore, considering the great difficulties generally attending inventive pursuits, and that "the labourer is worthy of his hire," it seems consistent with rational liberality, that those who may anticipate advantage or amusement from the production of any proposed novelty, should come forward with a moderate proportionate assistance, when needful, and warranted by previous exertions of the inventor.

1, *Waites' Place, Pratt-street, Camden Town, Aug.* 1830.

STEAM-CARRIAGES.

Sir,—The following arrangement has occurred to me as likely to remove some of the difficulties in the application of the steam-engine to the propelling of carriages. If you should consider the suggestion worthy of insertion in your Magazine, I shall be glad to see the remarks of some of your correspondents upon it.

Let there be two or more cylinders, having air-tight covers at one end and a piston to each, susceptible of motion, in an air-tight manner in the inside: let them be fixed horizontally, with the open ends at the back, on the carriage to be propelled. Now, supposing the piston to be in contact with the close top of one of them, the pressure of the atmosphere will resist any attempt to move the piston to the other end with the force of about 14lbs. on the square inch. If steam of greater force be admitted, the piston will of course be moved; and as there will be an equal pressure exerted by the steam on the cover of the cylinder, the carriage will be propelled in an opposite direction, in the same way as a gun recoils when discharged. A valve then being opened, the steam might be condensed or allowed to escape, and the piston again brought into contact with the cover of the cylinder, while another piston is moving in the same way.

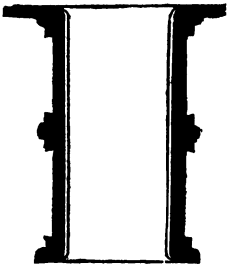
I shall not enter into the minute arrangements necessary, my object being to call attention to the possibility of employing the resistance of the atmosphere to a vacuum, as a fulcrum against which to exert the power of steam in the propelling of bodies.

I am, Sir,

Yours, &c.

P. H. G.

METHOD OF CONSTRUCTING CYLINDERS, FOR HYDRAULIC MODELS, &c.



Sir,—The following method of constructing small cylinders, for hydraulic models, may perhaps be acceptable to some of your readers.

Wanting some small cylinders, and being unable to cast them in brass, or to bore them out when cast, I set myself to work to find a substitute, and found a very good one, in drawn brass tubing, as stated at page 159, vol. xi.

I have since, however, tried another method, which answers extremely well, and is, in some respects, preferable to the former. This plan consists in casting a *pewter cylinder* with a *brass bore or lining*. To effect this, I turn a pattern of the intended cylinder in wood, and mould it in sand, in the usual way. For a core, I take a piece of drawn brass tubing, of the bore required, and nicely cleaned upon the outside. I then cast with hard pewter; the result is a pewter cylinder with a brass bore, of which the prefixed sketch is a section—the light part showing the brass

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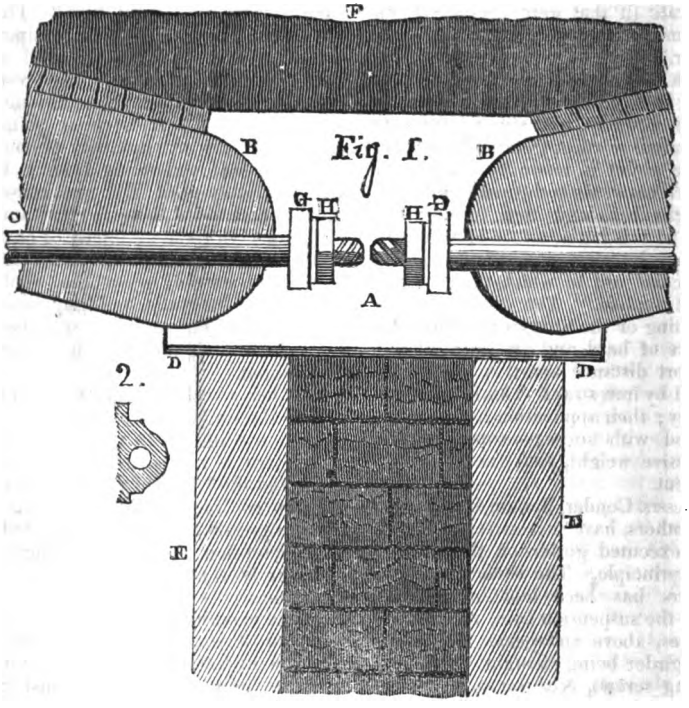
lining, and the dark shade the pewter exterior.

In this way cylinders, for models of pumps, steam-engines, &c. may be constructed with considerable ease; the *difficulty* or *expense* of boring being wholly superseded. The pewter gives an ornamental exterior, and the brass lining gives strength and durability.

I am, Sir,
Yours, &c.
W. BADDELEY, Jun.

August 10, 1830.

CRITICAL EXAMINATION OF THE NEW BRESTSUMMER IN BISHOPSGATE-STREET.



Sir,—The defects of the common brestsummer were always known to be so great, that plans have not been wanting to supersede the clumsy log of wood usually known by that name. These plans, however, have not come into general use till very lately; builders have at last studied their own interest and character in introducing trusses of various modifications. Nothing, in fact, can be more inefficient than the horizontal timber support (without a truss) of heavy scantling, supported by those vertical timbers called story-posts. In addition to the brestsummer being acted upon laterally, the removal of the supports immediately underneath (a thing of frequent occurrence) endangers the whole fabric; and enormous expense is often occasioned by the shoring and heedling that are indispensable when any alterations are required. The common truss-girders, now so often employed, were evidently a great improvement on the unscientific method before in use; but although they possess considerable strength, the iron is not employed in the best manner, and considerable

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pains and labour are required to bring the truss into that state of excitement so necessary for its stability. The adoption of iron only is also a defect; for without the iron columns, the longitudinal support is very likely indeed to snap asunder—a circumstance that has recently taken place in a large building, which I must be excused for not naming: the mere fact, I trust, will be sufficient to corroborate (if that were necessary) the statements I lay before your readers.

Mr. Smart, of Lambeth, has done much for the advancement of stability in buildings; his wrought-iron beam, and bow, and string rafter, are inventions worthy of particular notice. "The girder is made by welding an arched bar of wrought-iron to a longer straight bar, and then turning the ends of this latter, either up or down, as may be most convenient for the particular use to which the girder is to be applied." The giving way, or buckling of the arch, is prevented by blocks of hard and dry wood, placed a short distance apart, properly secured by iron straps. This is not mere theory; their application has been attended with success—supporting an excessive weight, free from all settlement.

Messrs. Conder, Renton, Gutteridge, and others, have successively planned and executed girders on the suspension principle. The timber in these girders has been laid horizontally with the suspension bars, in some instances, above and below the beam. The girder being brought up by adjusting screws, &c. the superincumbent weight on the beam will of course bring those bars into a state of tension. Much more may still be accomplished in making these supports fire-proof. To prove that the spirit of security and improvement in these matters is at last abroad, I need but refer to the late alterations at "Thompson and Fearon's," Holborn-hill, where will be seen a *ground-story fire-proof*.

I am far from thinking that the inclined and suspension brestsummer in Bishopsgate-street is not a still farther improvement in the suspension-brestsummer before described; I am therefore tempted to enclose figs. 1 and 2, to correct the misrepresentations attached so inconsiderately to the drawings of your correspondent, "Vulcan." The part of the brestsummer that I have chosen for illustration is the abutment-plate between the two pair of principles, resting on the party-wall and story-posts of the two houses. It is difficult to imagine what your correspondent meant by saying that "a building resting on such a prop, &c. is not sure." The old brestsummers, it is true, rest upon props. The bearing in the wall is very slight indeed; but the brestsummer in question needs no such adjuncts. The perpendicular points of support are uncommonly strong; the party-wall extending from E to E,* the story-posts EE are consequently embedded therein. The same is the case with the extremity of each house. Add to this the abutment-plates rest entirely upon the whole thickness of the walls, besides projecting a few inches on each side (see DD), with their proper wedge-plates of cast-iron.

Another excellent feature is, the raising the timber portion of the truss to an obtuse angle. In the horizontal truss there is not so much room to withstand the efforts of a heavy building from settling. In the present one, the compression of timber is exerted, and the tension of a 2-inch wrought-iron bar is continually operating in its favour.

In the experiments of Messrs. Telford and Brown, at Brunton's chain-cable manufactory, Welsh and Staffordshire iron was found to sustain upwards of 29 and 25 tons upon the inch area respectively; but Mr. Gutteridge says,† "none of these results should be estimated upon for weights to be borne in the ordinary lateral manner, as it is not possible so to adjust the weight as to give a mere exertion longitudinally; some 8 or 10 tons to the inch *area* will be a much safer estimate."

Explanation of the Drawings.

A, iron abutment-plate for the reception of timber principals BB.

BB, the timber principals.

* At least two bricks in thickness.

† Register of Arts, Part 15, N. S.

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CC, suspension bars.
DD, wedge-plates.
EE, story-posts.
F, brick-work over the front, worked brick-on-edge over the timbers.
GG, projecting ears (shown in profile, fig. 2), through which the bars CC pass.*
HH, nuts and washers, screwed firmly on the ends of the suspension-bars forming the abutments.

The observation of your correspondent respecting the corner house is absurd; and as to the object of the truss being to avoid the use of story-posts, this may be conceded to him; but the principal object was stability, which I am of opinion has been fully accomplished. The mode of upholding the joists of the one pair story, by strap-irons clipping the brestsummer, is not certainly so good as it might have been. Why not have arched it with coombs, and laid the joists of smaller scantling thereon?

I am, Sir,
Yours, &c.
C. DAVY.

Furnival's Inn,
August 8, 1830.

REMARKS ON MR. THOMAS DAVY'S GEOLOGICAL THEORY.

Sir,—Without entering into a full consideration of Mr. Davy's geological communication (p. 395), I would offer a few observations on one or two of Mr. Davy's leading "thoughts."

Your correspondent believes it to be the generally received opinion, that "all things were created out of nothing (a most unphilosophical mode of expression), about 6000 years ago, and that in the space of six days."

His objection to the limitation of the work of creation to six solar days is not new. The Wernerian geological hypothesis requiring a great length of time for the formation of the world, its advocates have endeavoured to prove that the "days" mentioned by Moses are not twenty-four hour portions of time. A modern writer (Dr. Good) observes:—

"Nor let it be supposed for a moment, that the term *day* in the Hebrew tongue seems to demand a limitation to the period of four-and-twenty hours, as it ordinarily imports; for there is no term in any language that is used with a wider latitude of construction than the Hebrew יום which is the word for *day* in the original. We are constantly, indeed, employing this very word, as Englishmen, with no small degree of freedom in our own age: for you will all allow me to drop the phrase "in our own AGE," and to adopt "in our own DAY" in its stead; thus making AGE and DAY terms of similar import. But in Hebrew the same term is employed, if possible, in a still wider range of interpretation: for it not only denotes, as with ourselves, half a diurnal revolution of the earth, or a whole diurnal revolution, but in many instances an entire year or revolution of the earth round the sun, and this not only in the prophetic writings, but in plain historical narrative as well. Thus in Exodus xiii. 10. the verse, "thou shalt keep this ordinance in its season *from year to year*," if literally rendered, would be, "*through days of days*," or "*through days upon days.*" And in like manner, Judges xvii. 16, "I will give thee ten *shekels* of silver by the *year*:" if strictly interpreted, would be "*per dies—for the days;*" that is, for the ANNUAL CIRCLE OF DAYS." Sometimes, again, the Hebrew יום, or *day*, comprises the whole term of life, as in 1 Chron. xxix. 15, "Our DAYS (ימינו) on earth are a shadow. And there is none abiding." So again, Job xiv. 6, "Turn from him that he may rest. Till he shall accomplish as an hireling his DAY" —יומו. But the clearest and most pertinent proof of the latitude with which the term יום, or DAY, is employed in the Hebrew Scriptures, is in the very narrative of the creation before us: for after having stated in the first chapter of Genesis that the work of creation occupied a period of SIX DAYS, the same inspired writer, in recapitulating his statement, ch. ii. 4, proceeds to tell us, "these are"—or rather, "*such were* the GENERATIONS of the heavens and of the

* This is the only objectionable part in the truss; coupling-plates would have been more secure, but even as it is, fear is out of the question.

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earth when they were created; in the DAY (בְּיוֹם) that the Lord God made the earth and the heavens." In which passages, Moses directly tells us, that in the preceding chapter he has used the term יוֹם, DAY, in the sense of generation, succession, or epoch; while we find him here extending the same term DAY to the whole hexameron, the entire term of time, whatever it may be, that these six days or generations filled up. So that the sense given to the word by Moses, instead of limiting us to the idea of twenty-four hours' duration, naturally leads us to ascribe, not only a different, but a much enlarged extent of time to the divisions he has marked by the word יוֹם, or DAY.*

My object in laying the above extract before your readers, is to show that the opinion which Mr. Davy merely adumbrates has been fully stated and defended long ago.

Although Dr. Good's object is to prove the validity of the Wernerian hypothesis, yet it should be particularly observed that the truth of the above observations does not in the least depend upon the hypothesis. Whether we adopt the Plutonian or the Neptunian cosmogonies, or whether, with a recent talented writer (Dr. Ure), discard both as visionary, yet will these observations be wholly unaffected. They are purely philological, and as such are to be tried by their own standard, which is altogether independent of any geological system.

The co-eternity of matter with the Deity appears to be Mr. Davy's next leading "thought." Having in about twenty lines settled this important point, your correspondent proceeds to earth-building in right earnest. He finds but little, if any, difficulty in the performance of his task: he says, let it be done, and it is done. "Mountains and other irregularities," shell-fish, polypi, coralines, liverwort, fishes, reptiles, birds, quadrupeds, and, lastly, man, spring successively into existence.

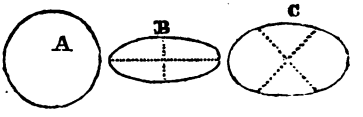
Preceding geological theorists have generally attempted to prove a coincidence between their theories and the phenomena of nature, and by the latter to support the former. Mr. Thomas Davy adopts a different course, and, in my very humble opinion, he does wisely—"facts are stubborn things."

I shall probably devote another letter to a consideration of Mr. Davy's "thoughts" on the eternity of matter.

I am, Sir,
Yours. &c.
SIGMA.

* Dr. Good, "Book of Nature," i. 165 and 167.

REMARKS ON MR. STRUVE'S PROOF OF THE ECCENTRICITY OF SATURN'S RING. SEE "MECHANICS' MAGAZINE," NO. 344, P. 30.



Sir,—It seems that experienced astronomers persisted in believing that the eccentric appearance of Saturn's ring was an "optical illusion," until convinced by the experiments made by Mr. Struve that the eccentricity was real. The soundness of the new opinion I am no way qualified to dispute; but if Mr. Struve made his measurements without calculating on the effect produced by the *perspective view* of a circle, the eccentric appearance may perhaps yet be proved an illusion, by reference to the three simple diagrams above, which if not an insult to those learned gentlemen, will show, that although the centre of a circle must always be as at A, yet it will not bear a geometrical measurement to that effect when viewed in any *oblique direction*. For although by practical observation we never doubt the fact of the centres of such views of a circle as B and C being central, yet when absolutely measured on a vertical plane, the perspective centre of the circle will not be the geometrical centre of the ellipsis formed by the perspective view of the circle.

I am, Sir,
Your obedient servant,
NO ASTRONOMER.

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SIR ISAAC NEWTON'S ARITHMETICAL QUESTION.

Sir,—Your scientific correspondent, "A Cambridge Student," requests me to make the corollary, which I have added at the end of my general solution (No. 363, p. 339), of Sir Isaac Newton's question somewhat more intelligible. As far as I can I willingly comply with his request.

In my general solution I trust I have satisfactorily proved that $qdf - aPc$ is a measure of the growth of the grass for the time $f - c$ $\therefore$ if $x =$ number of oxen that the growth of the grass alone on the meadow g will suffice to feed them $(f-c)$ $x = qdf - aPc$ $\therefore$ $x = \frac{qdf - aPc}{f-c} = 21\frac{1}{3}$ oxen.

Or, we might arrive at the same conclusion by the following method:—

Instead of finding how many oxen will eat up the pasture g in any given time h, find the number of oxen that may be fed on the pasture g when the time h is infinite, or, in other words, to find the number of oxen that may be fed on the growth of the grass. Referring to the general equation, $x = \frac{qdf(h-c) - aPc(h-f)}{h(f-c)}$; since h is infinite, and c and f are both finite quantities $\therefore$ $h - c$ and $h - f$ will each of them be equal to h, wherefore, $\frac{qdf(h-c) - aPc(h-f)}{h(f-c)}$ becomes $\frac{qdfh - aPch}{h(f-c)} = \frac{qdf - aPc}{f-c}$ the same as before.

In proof of the above, suppose it were required to find in what time (h) will $21\frac{1}{3}$ oxen eat up the pasture g? From the general equation we obtain $h = \frac{(qd - aP)cf}{qdf - aPc + (c-f)x}$. But since $x(f-c) = qdf - aPc$ $\therefore$ $qdf - aPc + (c-f)x = o$, therefore $h = \frac{(qd - aP)cf}{o}$ which is an expression for infinity. That is, if the grass were never to cease growing, the meadow g would continue for ever to feed $\frac{qdf - aPc}{f-c}(21\frac{1}{3})$ oxen.

Yours, &c.

G. S.

August 14, 1830.

P. S.—Since writing the above, I have seen Mr. Utting's arithmetical solution of the question. Your own remarks, Mr. Editor, save me the trouble of making many observations on it. But it is singular, that after having seen the question twice enunciated, and five different solutions of it given in the Magazine, all agreeing with that of Sir Isaac Newton, Mr. Utting should have fallen into such a blunder. If he had only considered sufficiently the first line of any of the solutions, he would have discovered his error; he has evidently not done so, and hence has pronounced them all to be erroneous.

Sir,—I beg to inform you that the difference in the solutions to Sir Isaac Newton's arithmetical question, as given by me, and your other correspondents, originated in my assuming $b = 3\frac{1}{2}$, instead of $3\frac{1}{3}$, as you remarked in your last Number, owing to the fraction being imperfectly printed in my copy, as had I referred to the question, vol. xii. p. 360, twenty times over, I should have read it the same, *i. e.* $3\frac{1}{3}$.

If, however, $3\frac{1}{3}$ be substituted, the result will by my method of solution be precisely the same as that of your other correspondents; but more particularly with that of your correspondent, G. S., as he has given in the corollary to his general solution the number of oxen fed on the grass of the after-growth, which your other correspondents have not done.

Mr. Latham (see p. 340) has, notwithstanding his remark in respect to the grass *not growing*, &c., given the same answer as your other correspondents, *i. e.* on the supposition that the grass *grows uniformly*: "which supposition is rendered sufficiently evident from the result deduced from Sir Isaac Newton's formula, as compared with my solution"—see pp. 411 and 412. As the two results will be the same, whatever numbers may be assumed in the question, G. S. will, I trust, accept the above explanation as an apology for what I asserted in my answer to the remarks of Mr. N. Logan, p. 410. My solution is, however, perfectly correct, according with

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the question, at the head of my solution (see p. 411).

I am, Sir,
Yours, &c.
J. UTTING.

Lynn Regis, Aug. 16, 1830.

Erratum.—P. 411, first line, for *bdefg* read *bdcfg*.

[We have also received a letter on the subject of the solutions of this question from Dr. Pat. Gillespie, in which he shows at some length, and with a great deal of algebraic cleverness, that Mr. Utting is correct, if we assume, as he does, the extent of the pasture to be 3½ instead of 3¼ acres. But after the communication we have just inserted from Mr. Utting himself, explaining how he fell into the error of making this assumption, the insertion of Dr. Gillespie's paper seems unnecessary. There is one sentence in Dr. Gillespie's letter, however, which we must quote, as it disposes of an objection which has been urged by two other correspondents to our entertaining this question at all. "The question," says Dr. Gillespie, "is not one of mere amusing speculation, but *one of practical and very useful application.*"—ED. M. M.]

THE NEW LONDON BRIDGE APPROACHES.

Sir,—In your Magazine of last week, your correspondent, Mr. Davy, has favoured the public with a plan which he calls "Jeffery's Plan of Approaches to London Bridge." I am sorry I had not the pleasure of seeing Mr. Davy or you before the engraving was made; that I might have given you a correct description, by which a very material error would have been avoided.

In order that your numerous readers may have a correct notion of my plan for approaches to the bridge, I will state, that according to my design the new street from the bridge to Gracechurch-street would have been on a level, and that to Cannon-street (being a part of the intended new street to Princes-street by the Bank of England, through the site lately occupied by the Old Post Office), would have been at an inclination of one foot in 100 feet, passing over the arch I suggested to be made at Thames-street, which I understand is to be called "Jeffery's Arch."

From Fish-street-hill, opposite the Monument, a communication with the new road should be made by a commodious flight of steps, and would afford a good view of that noble pillar; the proposed side-streets, one leading from the new line of street to the Monument, the other to Upper Thames-street at the bottom of Martin's-lane, should in nowise be made, as they would prevent the main approaches being kept on a level.

The communication between the bottom of Fish-street-hill, Thames-street, and the bridge, should be made in the manner shown by your plate, on an embankment of the recess in the river, extending from the east side of the new bridge to Cox's Quay, passing over a sub-steam wharf, alongside of which wharf vessels of that description would always lie afloat, and passengers would embark or disembark without having recourse to wherries; the entrance to the wharf for waggons would be in Thames-street. Over the wharf an hotel or any other description of building could be erected, that would correspond with the new Fishmongers' Hall, which it is intended shall be built on the site of the old hall, as is shown by your plate; and in front of St. Michael's Church, a banking-house or fire-office might be erected, which would have a very imposing effect when viewed from the bridge in conjunction with St. Magnus Church, the Monument, and the new buildings just enumerated.

If the new streets to the bridge shall be made on a level, in like manner as the Waterloo Bridge is, on the Strand side of the river, which the public have been led to expect would be the case, the entrance to the City from the Borough will be the most handsome of all the numerous approaches; to effect this is the grand consideration, and to which all others ought to give way. And as the final settlement of the plan of approaches is left to the Lords of the Treasury, and as they have employed that able

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architect, Mr. Smirke, to prepare plans of the elevations, it is confidently hoped, he will not sanction the ascending and descending communication proposed by Mr. Rennie, to avoid which the arch over Thames-street was especially designed; but that he will recommend the main approaches to be kept level, and discountenance the side approaches to Martin's-lane and to the Monument, and thus show the world that the public convenience shall not be subservient to private interest.

PETER JEFFERY.

81, *Cheapside, Aug.* 17, 1330.

Sir,—The arch to connect Upper and Lower Thames-street was proposed by Mr. Ralph Dodd in a pamphlet published in 1820, and I am inclined to believe still earlier in other pamphlets on London Bridge. The plan, indeed, of an archway for one road of communication over or under another is so common at Edinburgh, Glasgow, Aberdeen, &c., and in many of our canals (not forgetting the Highgate Archway, of which you have given so good an engraving in the last Number of your "Spirit of Literature"), that whoever the person may be who recommended it for adoption in London, he cannot on that account claim the merit of an inventor. The wonder is that an expedient at once so obvious and so useful, should not have obtained attention from the wise men concerned in the erection of the New London Bridge until it was forced upon them by others, and that even now they are going about it in so bungling a manner.

I am, Sir,
Your constant reader,
L. L. D.

August 15, 1830.

PROJECTILES-EXTRAORDINARY.

[The effect described in the first part of the following communication, for which we are indebted to an officer of the army, and an eye-witness, is so extremely peculiar, that we feel induced to point it out to the attention of our scientific readers, as well worthy of investigation.—EDIT.]

The natives of New South Wales have the art of throwing a curved flat stick, made of very heavy wood, and in the form of a crescent, with such force and accuracy, as to break a man's leg at sixty or eighty yards; but the strange peculiarity of it is, that it can also be thrown to the distance of a hundred yards and upwards in the air, and, without striking any thing, will return to the person who threw it, and even pass beyond him twenty or thirty yards. A similar stick is used by a people to the southward of Trichinopoly, the Colareese: they, however, only use it for straightforward purposes, and do not understand how to make it return. Captain Cook, when at Botany Bay, having seen the Bomarang, concluded it was a wooden sword; and under that idea, conjectured that the natives of New South Wales were descended from Malays, from the supposed similarity of the Bomarang to the Malay sword. The New Hollanders also have a method of discharging their spears, which surpasses any other that I have heard or read of. The spears they use are from seven to eight feet long, and they are cast by means of a flat stick called a Womora, about a yard in length, with a sort of hook at the point of it, on which the hinder end of the spear rests; this stick acts as a sling or lever; by this means the spear can be thrown to the distance of a hundred and twenty yards: with the hand alone, the spear cannot be thrown beyond fifty yards.

J. N.

INVOLUTE AND EPICYCLOIDAL TEETH.

Sir,—I am sorry S. Y. (an Engineer) has taken offence at your refusal to have another engraving executed, of double the size and "done to a hair," because the subject is one of considerable interest to the mechanical world, and but little, if at all, treated of, by the best authors on the subject. I certainly can see no earthly reason for his demands.

I would however ask S. Y. whether he thinks he has given a fair

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comparison of the two forms; and whether teeth are not oftener formed so that the action begins *before*, and ceases *after*, passing the line of centres. In this case they are partly exterior and partly interior epicycloids, the latter generally straight lines tending to the centre. Now the slide when the wheels are nearly equal is less in this than in the example given by S. Y. For the degree of sliding increases in *a greater ratio* than the angle of deviation from the line of centre. Therefore, the slide of a tooth where the action continues through any given arc will be *more* than double the slide of one describing half that arc (meaning in both cases from the line of centres)—and similarly, a tooth which passes half this arc before, and half after passing that line, will altogether slide less than one where the action continues through the *same arc or angle*, but entirely on one side the line of centres, as in the engraving at p. 283 of this volume.

It remains, therefore, to determine *generally* the slide of this form as compared with the involutes, for the question of *sliding* cannot be decided without. Perhaps S. Y. will have the goodness to favour us with these measurements.

Whether it be a little greater or less, I however consider the involutes as decidedly superior in practice for three simple reasons:—

1. A wheel with epicycloidal teeth can drive *uniformly* pinions of only one size.

2. If the distance of the centres (when epicycloidal teeth are used) are at all varied, uniformity ceases; neither of which facts can be objected to the involute teeth.

3. Involutes are easier described than epicycloids.

Yours, &c.

R. C. Jun.

BELL-RINGING—REPLY BY MR. HARRISON TO MR. BADDELEY'S PAPER, NO. 363, P. 349.

Sir,—I cannot agree with Mr. Baddeley that 57 lines of my paper, at p. 163, are occupied in "ridiculing" Mr. Drury's mode of ringing bells; but rather that those lines are occupied in explaining its properties and pointing out its defects; and I think the generality of your readers will coincide with me in this sentiment.

Neither can I admit that the other 15 lines are occupied in *mere allusions* to another plan, having expressly said in the same page that those tolling-hammers "are fixed a good deal similar to church-clock hammers;" of which and chime-hammers there are thousands in the kingdom (there being scarcely any part where the former, at least, do not abound), so that there did not appear any necessity for farther description, certainly no need of a sketch. As to Mr. Baddeley's opinion and mine having differed much on this subject, I consider it to be a case of *both necessity and right*, that every man must needs entertain his own opinion till sufficient reason appears to occasion a change. And though no one can be more deserving of being obliged, than one whose numerous valuable communications bespeak a laudable ardour to promote useful arts and inventions, yet I am still of opinion that the trouble of sketching and engraving any thing so common is quite unnecessary—the difference between tolling hammers and clock-hammers being only this, that the one is pulled up by a string and the other by its connexion with the clock, and that the former requires a stop to be placed to prevent *the hammer-head* from being pulled up too high; the manner of doing which, though it may vary according to local circumstances, will easily occur to any mechanic.

The idea Mr. Baddeley entertains of the insufficiency of this mode of striking bells, may possibly have originated from the circumstance that few church-clock hammers give blows half sufficient to produce the full sounds of the bells. But this is frequently owing to the clocks being too diminutive in size and power to lift hammers of a suitable weight to a sufficient height. The hammers, too, are much oftener rendered still less effective by an unskilful manner of connecting them with the clocks, whereby a great part of the effort of the machinery (small as it may be) is lost. Nevertheless, it cannot be a question but that the weight of tolling-hammers and the height to which they may be allowed to rise, may be such as to bring forth the utmost sound which bells can give, and at the same time preserve all their mellowness of tone.

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Whether in any particular case "comparisons" may or may not be "odious," it is certain that they are often very useful and instructive. On comparing things together the mind is commonly enabled to form a just decision as to the preference: but in the case of the two methods for uniformly producing the full sounds and best tone of bells, there seems to be scarcely any comparison, and I am not conscious of having attempted to make any.

Notwithstanding the fact that church-clock hammers seldom produce a sound equal in loudness to that which proceeds from ringing the bells, it experimentally appears (by some clocks fixed by my son) that bells admit of considerably greater sounds being elicited by the blows of the clock-hammers than can possibly be effected by their clappers in ringing; the bells being heard better and their sounds propagated to a greater distance by the striking of the clocks, than by the greatest blows of their clappers. The fact is, that bells will bear by far the heaviest blows on their outsides: whence the clapper of a bell, by striking on the inside, has a tendency to rive the bell asunder.

It is proper to add, that I cannot by any means consider Mr. Drury as "a rival tradesman," and consequently, that I have not been actuated by any of the feelings of a competitor. A new project was urged on public attention, which, though not destitute of ingenuity, was yet deficient in principle; and as a well-wisher to the arts of my country, I thought right to point out its defects, and mention one much better suited to the purpose: and although this might be expected to occasion Mr. Baddeley and Mr. Drury some chagrin at first, yet it is not improbable but it may ultimately save the latter gentleman considerable expense, besides loss of time and the mortification of disappointment. I could not have any interested motive, because I never sought to make any profit by tolling-hammers. When I have occasionally recommended them, I have given the people instructions to fix them themselves: and as to casting bells—as I never meddle with small ones—I don't see a possibility of Mr. Drury becoming a rival; since, on referring to the *causes* of the vibrations of bells, i. e. those principles by which the vibrating motion is enforced and supported, a very plain reason appears why his new and peculiar form answers so well for small bells; and from the same source may also be traced an equally plain reason why *it will not answer* for large ones: but I shall take a future opportunity to explain this matter.

I am, Sir,
Yours, &c.
JAMES HARRISON.

Barton-upon-Humber,
August 9, 1830.

Rice-Paper.—Sir, I beg leave to suggest to those who have more leisure than I have (although not more inclination) to imitate the (said to be) rice-paper, to try the soft substance in the large pod of the Windsor bean; and am yours, &c., W. GOODMAN, *August* 14, 1830.

Perpetual Motion.—Additional subscriptions received for the Experimental Project announced in our last Number.

Caroline John . . .	2*s.* 6*d.*
Anti-Dogma . . .	2 6

INTERIM NOTICES.

Since sending to the printer the papers on Sir Isaac Newton's arithmetical question, published in our present Number, we have received the communication of R. C., Jun. on the same subject, and also from an esteemed correspondent, a loan of "Wilder's Newton," with a recommendation to extract from it Sir Isaac's own solution, and Wilder's notes. We shall consider whether it is necessary to give any thing more on the subject.

We have received a long paper without any signature, but dated "Kintbury, August 16," in answer to our "Remarks" on the late decision of the Lord Chancellor in the case of Cochrane and Galloway against Braithwaite and Ericsson. We are quite prepared to maintain every thing we have advanced in these "Remarks;" but as our Kintbury correspondent admits that he had not the Number in which they appeared before him at the time he was writing, but spoke of them from "recollection" only (whence it has arisen that he has spoken very incorrectly), we submit to him, whether it would not be proper, first to ascertain distinctly, what it is we have said, before he proceeds to animadvert upon it. He is very much mistaken if he supposes that we have the slightest disinclination to the whole truth, in regard to the case in question, being made known. If he will make the necessary alterations in his letter, which a re-perusal of our remarks will doubtless suggest, it shall have a place.

T. M. B. will please inform us, whether, after the communication from Mr. Davy, which he will see in our present Number, he would wish his letter inserted.

Communications received from W.—Mr. W. Smith—Hesron—Unit—Mr. W. H. Simpson—S. P. W.—Mr. Webb—Iver Mackiver—Mr. Hughes—Gallus.

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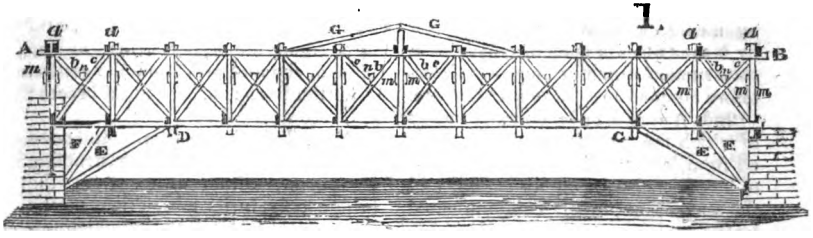
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 368.] SATURDAY, AUGUST 28, 1830. [Price 3d.

LONG'S WOODEN FRAME-BRIDGES.

1.



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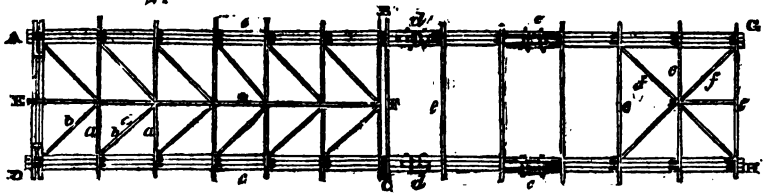

The road from Baltimore to Washington passes about 2¼ miles from the former place, over the Baltimore and Ohio Rail-road by means of a wooden bridge of a very novel and remarkable construction. The length or span of the bridge is 109 feet, its extreme width 24 feet, and its height from bottom to top of its posts, 14 feet. It is supported by a double truss-frame on each side, furnished with arch-braces beneath only; the upper arch-braces not being required in a bridge of that length. The exterior string-pieces of each string are only six inches square, and the interior six by eight inches. The posts at the ends, and at the centre of the bridge, as also the arch-braces, are of the size last mentioned. The other posts, and the main-braces, are six inches square. The counter and lateral braces are only five inches square. The whole of the timber, except the keys, is white pine, with no other seasoning than what it might have acquired in six weeks, during which time the work was in progress, having been framed and raised in that time by six workmen only. Independently of the abutments and exterior covering of the bridge, its cost, inclusive of materials and workmanship of every kind, was only about 1100 dollars. However slender the materials of which this bridge is composed, and however deficient in strength it may appear, it is crossed daily by stages at full speed, and has actually sustained about 80 beeves, driven across it at once, in close gang, without the least apparent yielding in the truss-frames. Agreeably to the most approved rules for computing the strength of similar structures, it will sustain, on every square foot of its floor, in addition to its own weight, at least 130 pounds, or equally distributed over the entire surface of its floor, about 110 tons weight.

The inventor of this mode of construction is a Colonel S. H. Long, of

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the United States Engineers, who has taken out a patent for it. The following additional explanations we extract from his specification.

The improvements which Colonel Long claims as new and original he classes under five distinct heads. He claims,

1st. Two modes of splicing the string-pieces, one of which is effected by means of wooden, and the other by means of iron splicing-pieces of a construction different from any heretofore adopted in bridge architecture.

2nd. A system of bracing, by means of which the truss-frames are exempted from leverage in every part liable to be affected by such an action, and the stresses or thrusts communicated by the braces, are resisted by shoulders or steps as nearly as may be at right angles with the grain, or fibres of the timber.

3d. A system of counterbalancing, by means of which the truss-frames are rendered stiff and unyielding, and the bridge kept in uniform action, whether loaded or unloaded.

4th. A mode of furnishing the main-braces and posts with metallic bearings, by the introduction of thin plates of iron, copper, or other suitable metal, between the *heel* and *toe* of each main-brace, and the steps in the post against which they thrust; and

5th. A mode of keying, or wedging, by means of which the central parts of the truss-frames, and consequently of the bridge, may be elevated, and sustained, in case of a subsidence or sinking of those parts, which is liable to happen from a shrinking and extraordinary compression of the timber.

These improvements are illustrated by a number of engravings, two of the most important of which will be found on our front-page.

Fig. 1. A side-view of a truss-frame exhibiting the systems of bracing adverted to in the 2nd and 3d of the improvements before enumerated.

A, B, the upper string, showing the position of its splices, and the insertions of the posts, &c.

C, D, the lower string with its splices, &c. *Note.* Inasmuch as the upper string acts by thrust, and the lower by tension, the splices of the latter only require particular care and precision in their adjustment.

E and F, inferior arch-braces, supported on the lower sill of the abutments, and inserted in the lower string immediately behind the 2nd and 3d posts from each extremity of the truss-frame. G, superior arch-braces connected with the centre-post prolonged above the frame, and inserted in the upper string, at the head of the 2nd post from the centre.

a, the posts; *b*, the main-braces; *c*, the counter-braces.

Note. This figure is also intended to indicate the manner of constructing a viaduct, which differs from the bridge only in its adaptation to the purposes of a rail-road, in which application the floor-timbers must be more frequent in order to afford an unyielding support to the rails, and the arrangements in other respects must be such as to admit the free and safe passage of a locomotive steam-engine.

m, the positions of clamp-bearers or floor-timbers, attached to the posts by means of screw-bolts.

n, the positions of intermediate floor-timbers resting upon the main and counter-braces at their junction and intersection, upper and lower.

Note. The relative distances between the strings and any two adjacent posts longitudinally of the truss-frame, should be about in the proportion of $1\frac{1}{2}$ to 1.

Fig. 2. A horizontal view of a bridge with single road-way and double truss-frames.

Note. The right half of this figure, viz. BC, GH, presents a view of the lower strings, floor-timbers, &c.; and the left, viz. ABCD, a view of the upper strings, bearers, lateral braces, &c.

E, F, a streamer, midway of the bridge, affording the means of connecting the lateral braces with the bearers.

a, the beams; *b*, the lateral braces; *c*, the splices of the upper and lower strings; *d*, the splices of the interior string-piece of the lower strings; *e*, the floor-timbers; *f*, lateral-braces connected with the floor-timbers; *g*, a short streamer affording the means of connecting the braces, *e*, with the floor-timbers.

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IRON BRESTSUMMERS.

Sir,—In the 365th Number of your Magazine, I observe a diagram and description of a truss (as a substitute for the old wood brestsummer) lately erected in Bishopsgate-street. Of the advantages and importance of the application there cannot be two opinions; but whether timber in combination with iron, be the most judicious mode of constructing it, may be worthy of farther inquiry.

The object is one of two-fold interest, viz. the possession of an uninterrupted space for shop fronts, and the prevention of those lamentable accidents which frequently occur from decay, or from the more alarming case of fire. Upon the latter view of the case, I certainly think it most advisable to dispense with the wood *in toto*, for under such circumstances the iron is rendered useless by the fallibility of the wood.

During the month of June, 1829, many of your readers observed the house, at present occupied by Messrs. Jennings and Co., booksellers, Cheapside, undergoing a thorough repair; and in order to obtain an uninterrupted shop front, the strong posts and wood brestsummer were removed, and a cast iron cradle, of a peculiar form, was substituted in its place, supported on two pilasters of the same material, in connexion with the party walls. The work was exposed to public view for several days, and I found upon inquiry, that the insertion was attended with a settlement of only one-eighth of an inch, which in an old structure evinced much care. Mr. Scandreh, architect, was the surveyor, to whose care the repairs and alterations were confided; and the cradle was executed and fixed by Messrs. Bramah's, who, I understand have, during the last five years, constructed several of the same kind, and some of considerable magnitude.

It is to be hoped that the wooden brestsummer will be entirely abolished in all new erections, as well for the sake of elegance, as for the security which iron affords to the building.

Although many cases of the like kind have recently occurred, I think the above testimony due to the individuals concerned.—Yours, &c.

A——N.

Regent-street, Aug. 21, 1830.

DECIMAL ARITHMETIC.

Sir,—Thankful for the favour of a reprint, entitled "Hints in Arithmetic," (see "Mechanics' Magazine," vol. xi. p. 276), I solicit a space in your columns for the performance of a promise to exemplify the advantages of decimal arithmetic.

To reduce from $\frac{1}{4}$ to 2 shillings for practice, leaving at most 3 factors, and the sum to be fully developed in 3 lines beyond the given line—a series of the most useful and easy exercises. Omitting the easiest, the following are sufficient:—

$2\frac{1}{8} = \frac{5}{480} = \frac{1}{8\times12}$

$3\frac{1}{4} = \frac{13}{12\times80}$ by 12 first and add.

$4\frac{1}{4} = \frac{17}{16\times60}$ by 16, as before.

$5\frac{1}{4} = \frac{23}{960} = \frac{115}{4800}$

$6\frac{1}{8} = \frac{13}{480}$ by 12, as before.

$8\frac{1}{8} = \frac{17}{480}$ by 16, as before.

$9\frac{1}{4} = \frac{37}{960} = \frac{111}{18\times160}$

$10\frac{1}{4} = \frac{43}{960} = \frac{129}{2880}$ as above.

$11\frac{1}{8} = \frac{23}{480} = \frac{69}{12\times120}$

$11\frac{1}{4} = \frac{47}{960} = \frac{141}{18\times120}$

$1\ 0\frac{1}{8} = \frac{25}{480} = \frac{1}{16\times1,2}$

$1\ 1\frac{1}{4} = \frac{53}{960} = \frac{106}{12\times160}$

$1\ 2 = \frac{14}{15\times16}$ by 15, and subtract.

$1\ 2\frac{1}{4} = \frac{57}{960} = \frac{114}{1920}$

Or thus $= \frac{57}{960} = \frac{19}{16\times20}$ as before.

$1\ 2\frac{1}{8} = \frac{29}{30\times16}$ as before.

$1\ 2\frac{1}{4} = \frac{59}{16\times60}$ as before.

$1\ 3\frac{1}{4} = \frac{61}{60\times16}$ divide and add.

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$1\ 3\frac{1}{2} = \frac{31}{30\times16}$ as before.

$1\ 3\frac{1}{4} = \frac{63}{960} = \frac{21}{16\times20}$ as before.

$1\ 4\frac{1}{2} = \frac{67}{960} = \frac{201}{16\times180}$

$1\ 5 = \frac{17}{15\times16}$ as before.

Here the 4th rule, twice already printed, may be adapted, as, Take the sum of the units and tens; to every product add the next left-hand figure in the multiplicand *wanting one.*

123 at 1 $6\frac{1}{4} = \frac{73}{960} = ,0704$

19.

2337

4

9,348 *Ans.* Here I suppose the decimal table learnt, and the extent of the error that must arise on the 4th omitted figure 4, clearly perceived as it affects the similar figure in the answer, being always in strict proportion to it, which is here 5, and making the answer right, namely, 9,353. Attend to this direction when you take an insufficient divisor. It is upon this simple principle that repetends and recurring decimals are considered terminate, without the labour of reducing them by rule, except in hazardous cases, which hardly amounts to an exception if the operation is a final one.

I shall rest here for the present, hardly knowing how far I ought to proceed. There are no bounds to the properties of numbers. Our own money is more easily reckoned than foreign money. Time, or the pendulum, is the standard of superficial measure, and weight of solid contents. When goods are not moveable, or when money is paid by instalments, the computation cannot be exact. Even timber is valued without certainty. Whether I am at liberty to apply the art of memory to the eight terms, for the table of parts of 112, all that is necessary to express any weight decimally, I know not, as it is best done in Latin, and always *ad libitum.*

I am, Sir,

Yours, &c.

E. S. L.

SOLUTIONS OF THE ARITHMETICAL QUESTION PROPOSED BY "IVER MACKIVER," VOL. XIII. P. 271.

By Mr. Hubert.

Sir,—I beg to hand you below a solution of the question (in the 358th Number of your interesting work), by "Iver Mackiver."

Let $x =$ the original capital, and as the rate of its accumulation is equal to 20 per cent. less by the annual expenditure, let $r = £1$, with its interest for 1 year $= 1{,}20$.

Then by the question,

$$x \times r^{15} - \frac{a \times r^{15} - a}{r - 1} = b$$

$$\therefore x = b + \frac{\frac{a \times r^{15} - a}{r - 1}}{r^{15}} \text{ or according to the figurate data}$$

$$x = 12000 + \frac{\frac{400 \times 1{,}20^{15} - 400}{,20}}{1{,}20^{15}} \text{ which when worked out by}$$

Mr. Woollgar's contracted "Table of Logarithms," gives £2650 as the original capital: but if worked out by Hutton's "Logarithms," the answer comes out £2649. 1*s.* which fully shows that contracted tables are not sufficiently accurate where the sums are large. The £2650, if im-

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proved according to the question, would amount to £12,014. 11*s.* by Hutton's tables.

Yours, &c.

H. HUBERT.

Rock Life Assurance Office,
July 6, 1830.

By Iver Mackiver, the Proposer.

First Solution by Algebra.

Let $R = 1\frac{1}{n}$ = amount of £1 on his gain per annum, x = original stock. Now, if he had employed his whole capital in trade, his new capital at the end of the first year would be Rx; at the end of the second year R^2x; and at the end of m years R^mx. But this is evidently too much by the amount of an annuity £a for m years at the rate R per cent. per annum, which is $\frac{R^m - 1}{R - 1}a$. Hence,

$$R^m x - \frac{R^m - 1}{R - 1}a = b$$

$$\therefore x = \left(b + \frac{R^m - 1}{R - 1}a\right)\frac{1}{R^m}$$

Here $R = 1{\cdot}2$, $m = 15$, $a = 400$, and $b = 12{,}000$. Log. R^m = log. $1{\cdot}2 \times 15 = 1{\cdot}1877180$ $\therefore$ $R^m = 15{\cdot}407$ $\therefore$ $x = \left(12{,}000 + \frac{14{\cdot}407}{0{\cdot}2}\right)\frac{1}{15{\cdot}407} = 2649{\cdot}055$ = £2649 1*s.* 1*d.*

Second Solution by Common Arithmetic.

If any number be increased by its $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, &c., the sum must be diminished by its $\frac{1}{1}$, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, &c., to produce the first number. Now, since the capital at the end of 15 years is £12,000, and as this sum is equal to the capital at the end of 14 years + $\frac{1}{5}$ of the same, £400 $\therefore$ the capital at the end of 14 years will be 12,000 + 400 — $\frac{1}{5}$ (12,000 + 400) and so on.

12000·	6 | 6418·775728	3345·879862
400·	1069·795955	400·
6 | 12400·	5348·979773	6 | 3745·879862
2066·666666	400·	624·313310
10333·333333	6 | 5748·979773	3121·566552
400·	958·163295	400·
6 | 10733·333333	4790·816478	6 | 3521·566552
1788·888888	400·	586·927759
8944·444444	6 | 5190·816478	2934·638793
400·	865·136079	400·
6 | 9344·444444	4325·680399	6 | 3334·638793
1557·407407	400·	555·773132
7787·037037	6 | 4725·680399	2778·865661
400·	787·613399	400·
6 | 8187·037037	3938·067000	6 | 3178·865661
1364·506163	400·	529·810943
6822·530874	6 | 4338·067000	2649·054718
400·	723·011166	Or,
6 | 7222·530874	3615·055834	£2649. 1*s.* 1*d.*
1203·755146	400·	the same as
6018·775728	6 | 4015·055834	before.
400·	669·175972	
6418·775728	3343·879862	

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THE THAMES BELOW NEW LONDON BRIDGE.

Sir,—Your correspondents seem disposed to pay an adequate attention to the approaches to London Bridge *by land;* but as yet, I think, they do not sufficiently regard the importance of securing the approaches to the new structure *by water.* In other words, I see no evidence at present, that due precautions have been taken to preserve the navigation of the river, and the neighbouring wharfs, buildings, and lands, from the evils that will arise from the extreme shallowness that may be anticipated at low-water, and the overflowings that may result from only moderate spring-tides when the dam constituted by Old London Bridge is removed. Three or four of your correspondents drew the public attention to these momentous points about nine months ago;* but their interesting communications do not seem to have made the general impression that might naturally have been looked for.

In this case, which may, alas! (if the present indifference continues to prevail), in a very few months become a case of emergency, perhaps you will allow me to propose a few questions for the serious consideration of all who have property on the banks of the Thames, or who have business or vessels on the Thames, or who are engaged in the commerce of our vast metropolis.

Quest. 1. Does not the old bridge operate as a dam to prevent the escape of a certain portion of the western waters, which would otherwise go off to the Nore?

2. Does not it also operate as a dam to check the tidal water in its passage up the Thames?

3. What will be the principal effects when this dam is removed?

4. Is there not a permanent dam at Teddington, and another at Moulsey, for the purpose of keeping up and preserving the upland water?

5. Is not the head of water kept up at the Teddington lock, or dam, about *one* foot in winter and *four* in summer? And are not the quantities kept up at Moulsey about the same?

6. Is it wise, when these dams are known to be *necessary*, even with the aid of the London Bridge dam, to propose removing the latter without any provision against the evils which its removal may occasion?

7. Will it not be often necessary, after the removal of this dam, to dredge out a channel for the current at low-water?

8. Who is to be at the expense of this? And what will be the consequence if it be neglected?

9. Will it not be necessary to narrow the river in various parts? And if so, at whose expense is this to be effected?

10. Will it not be necessary often to remove shoals and sand-banks, occasioned by the alteration in the direction of the mid-stream? And if so, again at whose expense?

11. Will not the occasional construction of the river, of necessity, involve a corresponding protrusion of the wharfs, storehouses, &c., upon their present bed at those places? Again, at whose expense?

12. Since the piers of Westminster, of Blackfriars, and Vauxhall Bridges, do not stand upon piles, and extend but a little way below the present bed, will it not be necessary to secure them by the erection of starlings around them? And where is this expense to be thrown?

13. Who is to make compensation to persons possessed of wharfs, storehouses, &c., adapted to the present state of the river, especially above bridge, for diminution in their value, and in some cases a total destruction of their use, occasioned by contracting the bed of the river, or by alterations in the course of the stream?

14. Who is to be at the expense of raising the river banks where necessary; or who is to remunerate the proprietors of lands on both sides for injury done by inundations if these embankments are not raised?

A

It is pretty well known that from Teddington to Cotton Stairs, near Westminster Bridge (viz. nearly 20 miles of each bank), the river walls are not sufficiently elevated to keep out a high spring-tide, such, for example, as that of December 26, 1824, and after the old bridge is removed,

* See "Mechanics' Magazine," vol. xli. p. 338.

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there is every reason to believe that a tide but little exceeding an ordinary spring-tide will produce the same effect. Should this be realized, in fact, as is but too probable, it will be found that the embankment is too low by a foot at Twickenham, and that the evil gradually increases until, at Cotton Garden Stairs, the embankment will be nearly two and a half feet too low. If, therefore, the banks are not raised, what will preserve from frequent inundation the lands at Walham Green, Chelsea, Battersea Fields, &c.? And who is to make compensation for the injury thus done?

I have here, as you will perceive, Sir, shaped my questions so as to involve the consideration of *expense*, and thus reducing the matter to an argument of the *pocket*, which all will admit to be a serious mode of conducting an inquiry in these days. I have not yet prepared my estimate of these items of expense and loss; but I have no doubt that when the actual expenditure on these various accounts becomes really known, as well as the aggregate of the sums actually paid as compensation for houses taken down on both sides of the river, and the real expense of the structure and the land approaches, the whole will amount to at least A MILLION AND A HALF pounds sterling!! And this in order to build a bridge, for which there was no more absolute necessity than for *a bridge from Charing Cross to Westminster Abbey*.

I hope that you, Sir, will take up this matter soon, and treat it in your own lucid and convincing way. If not, I fear, you will, ere long, be troubled with another letter from

Your humble servant,

AQUARIUS.

ICE KEPT FROM MELTING BY RED HOT LAVA.

A remarkable discovery has lately been made on Etna, of a mass of ice, preserved for many ages, perhaps for centuries, from melting, by the singular event of a current of red hot lava having flowed over it. The following are the facts in attestation of a phenomenon which must at first sight appear of so paradoxical a character. The extraordinary heat experienced in the south of Europe during the summer and autumn of 1828, caused the supplies of snow and ice, which had been preserved in the spring of that year, for the use of Catania and the adjoining parts of Sicily and the neighbouring island of Malta, to fail entirely. Considerable distress was felt for the want of a commodity regarded in these countries as one of the necessaries of life rather than an article of luxury, and on the abundance of which, in some large cities, the salubrity of the water and the general health of the people may be said to depend. The magistrates of Catania applied to Signor M. Gemmelaro, in the hope that his local knowledge of Etna might enable him to point out some crevice or grotto in the mountain where drift snow was still preserved. Nor were they disappointed: for he had long suspected that a small mass of perennial ice at the foot of the highest cone was part of a larger and continuous glacier covered by a lava current. Having procured a large body of workmen, he quarried into this ice, and proved the super-position of the lava for several hundred yards, so as completely to satisfy himself that nothing but the subsequent flowing of the lava over the ice could account for the position of the glacier. Unfortunately for the geologist, the ice was so extremely hard, and the excavation so expensive, that there is no probability of the operation being renewed. On the 1st of December, 1828, I visited this spot, which is on the south-east side of the cone, and not far from the Casa Inglese; but the fresh snow had already nearly filled up the new opening, so that it had only the appearance of the mouth of a grotto. I do not, however, question the accuracy of the conclusion of Signor Gemmelaro, who being well acquainted with all the appearances of drift snow in the fissures and cavities of Etna, had recognised, even before the late excavations, the peculiar position of the ice in this locality. We may suppose, that at the commencement of the eruption a deep mass of drift snow had been covered by volcanic sand, showered down upon it before the descent of the lava. A dense stratum of this fine dust mixed with

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scoria is well known to be an excellent non-conductor of heat, and may thus have preserved the snow from complete fusion when the burning flood poured over it. The shepherds in the higher regions of Etna are accustomed to provide an annual store of snow to supply their flocks with water in the summer months, by simply strewing over the snow in the spring a layer of volcanic sand a few inches thick, which effectually prevents the sun from penetrating. When lava had once consolidated over a glacier at the height of ten thousand feet above the level of the sea, we may readily conceive that the ice would endure as long as the snow of Mont Blanc, unless melted by volcanic heat from below. When I visited the great crater in the beginning of winter (1828), I found the crevices in the interior encrusted with thick ice, and in some cases hot vapours were streaming out between masses of ice and the rugged and steep walls of the crater. After the discovery of Signor Gemmelaro, it would not be surprising to find in the cones of the Icelandic volcanoes repeated alternations of lava streams and glaciers.—*Lyall's Geology.*

IMPROVEMENT IN PARALLEL RULERS.

Sir,—In forming parallel lines, it frequently happens that two or more lines are required to be drawn perpendicular to the former ones, which, by the methods now practised, requires considerable time.

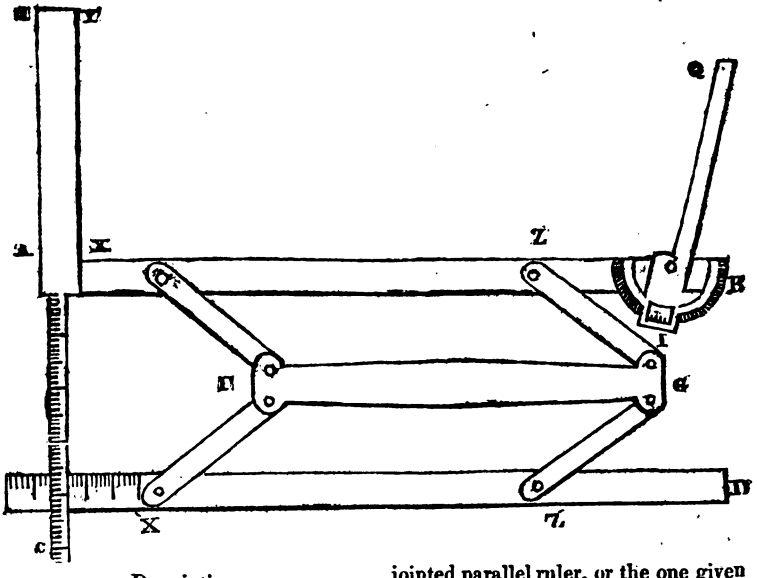
By the following adjustment this may be accomplished with a facility heretofore unknown; besides which, the marks and pin-holes, which are at present used as guides, to the great injury of drawings, are rendered unnecessary. If you think the improvement worthy a place in the "Mechanics' Magazine," its insertion will much oblige,

Sir,

Yours respectfully,

W. E.

Sunderland, July 1, 1830.



Description.

The addition here proposed applies to any of the forms of parallel rulers, but will answer best with the double-jointed parallel ruler, or the one given in the drawing.

AB, CD, F*x*, F*x*, Z*g*, Z*g*, represent the ruler, and AE*yx* the ad-

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dition, which should be a thin slip of sheet-brass, having parallel edges AE-*yx* bevelled. This piece of brass, which I will call the *square edge*, must be firmly fastened to the upper side of AB, near one of its ends—care being taken to set it at right angles to AB. For the convenience of carriage, it would be better to make a joint at A*x*, to allow AE to turn over upon C. This joint should have a considerable breadth to prevent shake, but must not come to the bevelled edge of AB.

On account of the double joints F*x*, F*x*, Z*g*, Z*g*, the square edge will have a considerable motion in the direction AB, as well as in that of AE; but the former will be double as much as the latter. This addition might be applied to the single-jointed, or common form of parallel rulers with considerable success; but would require more trouble in the management than with the double-jointed, because it would require the whole instrument to be shifted when parallel lines had to be drawn at large intervals by the square edge. This might be avoided by forming a groove on AB for AE to slide in; great care must be taken in the formation of such groove, otherwise the square edge would shake.

By lengthening AE (the straight edge) by AC, and dividing it into inches, tenths of inches, &c. and likewise dividing the ruler-plate CD (or a part of it) into inches, and tenths of an inch, &c. the sides of squares and parallelograms might be laid down without any other instrument.

By a farther addition, the sides and angles of triangles, and other straight-lined figures, might be drawn with it.

On the flat side of AB, and near its end, fasten a graduated semicircle TB (or which would be much better, let it be a part of AB), and from its centre let the nonius-piece TQ work. The edges of this nonius-piece must be well-finished and made parallel, and should have both edges bevelled. It may be fastened either upon the upper or under side of AB; but if on the under, a part of that surface of the ruler must be removed to bring the whole level, and allow them to lay upon the paper. If placed on the upper side, there would be a considerable space between the paper and it, which would be much better filled up with a piece of sheet-brass. On account of the motion of TQ, this piece of brass must be filed away on the back edge, bringing it to a point near the centre, which would allow the nonius-piece a motion backwards as well as forwards. If the divided semicircle were large, the nonius-piece would answer as a perpendicular piece.

STEAM-PLOUGHING.

Sir,—Although immediately engaged and interested in the advancement and dissemination of mechanical objects, I cannot pass over the 412th page of your present volume, without expressing a feeling which ought (especially at the present crisis) to characterise every patriotic mind.

None will be more ready, or can be more willing, to advocate the introduction of machinery where it facilitates the manufactures of the country, without which, that commerce so unrivalled, must necessarily fail; but I would positively forbid it where it entrenches on the existence of those who form so considerable a portion of society as the agricultural labourers, and whose present condition would rather move every humane heart to forego the trifling advantage, which can be better dispensed with by those who reap the fruits of the poor man's labour. There are limits to the introduction of particular systems, which propriety points out, beyond which, the injury inflicted on society more than counterbalances the advantages which they confer; and of such a nature I conceive the application of steam to agriculture to be; and I regret exceedingly, that such an object should find support in so respectable a work as the *Gardener's Magazine*.

The effect which must unavoidably be produced by such an introduction, may be ascertained by surveying the poor-houses throughout the country—by estimating the portion of the population which must of a consequence be added to their number—by examining the amount of poor's rates, which already press with such severity on the agricultural districts, and the difficulty with which they are met; and I think after such an investigation, few will be found who can conscien-

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tinuously recommend its adoption. Is it presumed that the work will be performed in a superior manner, or that time alone will be the saving? If the former, I have always understood that spade cultivation has been found the most efficient; and latterly, in many cases, from the extremely low price of labour, it has proved the most economical expedient.

If the latter reason be adduced, the means are already within reach, viz. by employing those who are ready and willing to labour.

None, I trust, will so far suffer individual interest to predominate over patriotic feeling, as to encourage such a perfect disregard of the sufferings of those families, whose existence must necessarily, by such adoption, be sacrificed to the pecuniary advantage of a few.

The channels of human labour ought not to be closed without providing the means of support for those whose existence depends upon them. It is a deplorable calamity when compassed by uncontrollable events.

I fear I have already trespassed too much on your kindness, and will not enter into the question of economy, which appears rather questionable; but conclude with hoping, that the sentiments herein expressed may meet with the reception due to the sincerity with which they are given.

I remain,
Yours, &c.
A. H.

Golden-square, Aug. 23, 1830.

AMERICAN IMPROVEMENT IN MORDAN'S EVER-POINTED PENCIL-CASE.

The last Number of the "Journal of the Franklin Institute" contains the following specification of a patent granted to Joseph Saxton, of Philadelphia, for what appears to be a very useful improvement in the ever-pointed pencil-cases of Mordan, now in such general use in England.

"The old construction of the ever-pointed pencil-case, on which said improvement is made, consists of a cylinder that slides inside of a case similar to those used for the ordinary cedar pencils, and may be slid in or out in the same way, being connected with the outer slide of the case by means of small pins or screws. Through the cylinder is cut a left-handed female screw, in which acts a male screw, to which is joined the small wire that propels the lead. Part of this screw is filed away, so as to form two flat surfaces in order to slide in a slit cut in a second cylinder, fitted exactly into the first, and made to extend a short distance above it. To the upper end of this small cylinder is fastened a collet, which projects over the end of the larger one; and while it permits this larger cylinder to revolve freely on the smaller, prevents the latter from drawing out. The lower end of this smaller cylinder projects a sufficient distance below the other, to be held between the fore finger and thumb of the left hand, and inasmuch as the small screw passes through the slit in this cylinder, it cannot turn, but as it acts in the thread of the outer cylinder which revolves by turning the case; this screw, to which the propeller is attached, must move either up or down, according to the way in which the case is turned.

"The improvement on the above described pencil-case, for which a patent is claimed, consists, first in screwing the point through which the lead is propelled into the first described or outer cylinder within the case, to which the external slide is attached, instead of the inner or second above described cylinder, thereby making but one sliding joint between the point and outer tube or case. Secondly, in simplifying it by continuing the female screw in said cylinder its full length; so that the male screw of the propeller may act in the same thread into which the point screws. Thirdly, in causing the propeller to move by means of a piece of square wire attached to the upper part of the screw, whereby said screw is left whole, and the thread continued all round; whereas in the other more than one-half of the screw is destroyed by flattening the sides, leaving but a small proportion of the thread to project out of the slit in the second described cylinder. By this new arrangement of the parts but one cylinder is required, which must be made of a size that will slide accurately in the outer tube or case. In this cylinder the propeller works by its screw made to fit in that of the cylinder. The upper or square end of this propeller must be rather more than double the length of the point through which the lead passes, so that it may always be within the square hole in the lower end of the tube above it, and within the outer

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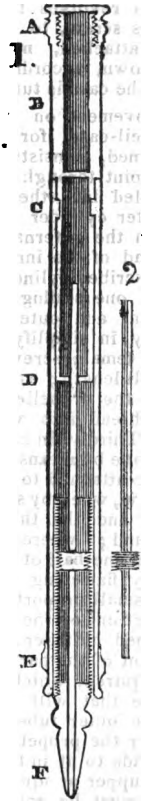
tube or case. In the upper end of this tube is fitted a plug, having one end fastened to it, and after fitting a collet or band that shall revolve on its plug, the other end is to be fastened permanently to the first or upper section of the outer tube or case; and this collet is then to be secured either by screw or otherwise to the inside of the upper end of the second section of the outer tube or case, which will prevent the inner tube or key that turns the propeller from having any lateral motion, but will permit it to revolve with the upper part of the case to which it is connected; and by turning which (the lower section being held firm) the propeller will move either up or down."



Description of the Drawings.

Fig. 1, a longitudinal section of the case.

Fig. 2, the propeller, with its screw; the upper part of the propeller being formed of square wire.

A, cap which screws on and closes the chamber for the spare pencils, and retains B in its place.

B, the part which is to be turned round to advance the pencil.

C, Collet, which is soft soldered to the outer tube, but allows the inner tube or plug to revolve when the part B is turned.

D, the lower end of the brass tube or plug, with a square hole in a piece which closes its end, through which the propeller slides.

E, the slide which retracts the point F, which point is screwed into the sliding tube; within this the female screw is shown, and the male screw of the propeller.

ACCOUNT OF AN EXTRAORDINARY ADHESION OF THE SAFETY VALVE OF THE BOILER ON BOARD THE STEAM-BOAT "LEGISLATOR," ON THE HUDSON. BY THE ENGINEER.

To the Editor of the Journal of the Franklin Institute.

Sir,—The late awful explosion of the steam-boat *Helen M'Gregor*, has brought to my recollection an accident that occurred last summer under my own eye. Believing it may serve the cause of humanity, I think it my duty to make public the fact: it is this.

Last summer I was engineer on board the steam-boat *Legislator*, belonging to Hudson; standing on the forward deck, I noticed that the engine was working faster than common, and not seeing any steam flow as usual from the safety valve, I started for the fire-room, where I met the fireman then on duty; he told me that he had on 21 inches of steam, and that the rod in the steam gauge was up against the boiler deck. As the safety valve was loaded to carry only 16 inches, I became alarmed, and went to the fire-room and took hold of a cord that ran over a pulley and was attached to the lever of the safety valve, and attempted to raise the valve, but could not; I was still more alarmed, and went on the top of the boiler, where the safety valve was, and found all right there, that is, there was no extra weight on the valve: I

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then slided the weight in to the length of the lever up to the fulcrum, where the weight was merely nominal; still the valve did not rise: I became confounded; I took hold of the lever and lifted on it pretty stoutly, and continued lifting for some seconds, when all of a sudden, with an explosion like that of the report of a small field-piece, the valve opened, and the steam rushed out violently; it continued to do so for some length of time before the steam got down to the usual pressure, the engine being at work all the time. There was no water on the valve, nor any visible obstruction to its rising of its own accord after the steam got beyond the pressure of 16 inches, which it had invariably done before. Now, sir, must not this obstruction to the valve rising have been caused by an adhesion that took place between the valve and the valve seat, both of the same metal—I think it certainly must have been caused by this adhesion of the metal only. I have had an experience of twelve years as an engineer, and never knew the like occurrence before. For many reasons I have not placed full reliance in the mercurial steam gauge, but have always had entire confidence in the correctness and safety of the safety valve; but in this case I was deceived, and perhaps in a few moments more an explosion might have taken place, for I have no doubt that if the small rod in the steam gauge had had a free passage through the boiler deck, it would have denoted 30 instead of 16 inches.

It is usual on board steam-boats to have the steam gauge so graduated as to show as many inches of steam as the engine will take, and to have the safety valve loaded so as to agree with the steam gauge, believing that when the steam gauge indicated 16 inches of steam, all the surplus steam would escape through the safety valve: engineers, or many of them, are in the habit of not blowing off any steam when the boat stops to make a landing, but depend wholly on the safety valve rising of itself after the steam has risen a little above its required height. This has been considered a safe way of proceeding; but the case stated above shows, most conclusively, that it is wrong to depend too much on the safety valve. I would recommend, by all means, that when a boat stops to land passengers, that the safety valve be raised, let the gauge indicate what pressure it may; this, sir, is the only safe way. Might not the engineer of the *Helen M'Gregor* have placed an implicit confidence in his safety valve rising when the steam had got to its required height; and is it not possible that an adhesion had taken place between the valve and the seat? And perhaps at the same time he was waiting for the valve to rise, he had double the required quantity of steam, which caused the awful explosion; such may have been the fact. Before the occurrence of my safety valve not rising when it ought, I had believed the cause of boilers exploding was, almost invariably, the want of a sufficient quantity of water. I now think some explosions may be attributed to the being deceived by the safety valve not rising as was expected by the engineer.

If you think the above stated facts are worth a place in your valuable Journal, you are at liberty to insert them. You will please to word and arrange this account to suit yourself. I know nothing about making out a statement for a public print, but you may rely on the correctness of the fact above narrated; it can be testified to by the pilot, the clerk, and the fireman of the boat.

I am, Sir,

Yours, &c.

J. B. CALHOUN, Engineer.

New York, April 12, 1830.

Remarks by Dr. Jones.

We differ from Mr. Calhoun in his estimate of the value of the mercurial steam gauge, and think that the case stated must convince him of its utility. In order to judge of the cause of the adhesion, the exact form of the valve, and other circumstances relating to it, ought to be known. So far as the account goes, it appears that there was, in the present case, an actual adhesion of the valve to its seat, which, although not unfrequent to a certain extent, existed with a degree of force which was extraordinary. Our scientific readers are acquainted with that kind of adhesion which was first brought into general notice by M. Clement, of France, and which has since given rise to much discussion; there is nothing, however, to lead to the conclusion that the present case was in any way related to it, as an emission of steam would then have accompanied the adhesion.

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A Sonnet.—No. V.

To the Founder of Mechanics' Institutions.

Let the bold warrior boast his laurell'd head,
To nourish which whole hecatombs have bled;
Let sages grey, with speculative lore,
Delight to scan their unproductive store,
Which clothed in ancient words of little worth,
Like precious seed unburied in the earth:
The petty pride of birth, the vaunt of power,
And all the gewgaw pageants of an hour,
Which glare a moment, and as quickly pass,
As airy shadows from the vacant glass;
Thou needst not covet—thy superior fame,
Shall live while Truth and Science have a name.
'Twas thy proud lot the common crowd to teach,
The fruit of Knowledge grows within *their* reach!

T. M. B.

PERPETUAL MOTION.

Sir,—The publication in your Magazine, p. 416, of the proposals I submitted to you and your friends, has placed me in a situation that makes it necessary to look about me, as no doubt there are few of your readers who have read them without feelings, either of pity or contempt. To those who may feel the former for me, I thank them; though, I must confess, it is a thing of which I do not much like to be the object. With those who may feel contempt for my pretensions, I should be glad to be better acquainted; and I boldly tell them, that all the arguments that have been brought forward with so much arrogance to show the futility, absurdity, weakness, &c. of the idea, and which have been kept up in a continual round from one hand to another till they are become quite common-place, have little or nothing to do with the subject, as it relates to a mechanical continually-moving machine, acted on by the perpetually existing powers of nature, and properties of matter. And I respectfully inform them, I shall be very ready to answer any objections to the best of my power, either through the medium of your work (subject, of course, to your discretion), or to attend to any private communications on the subject, through your hands, if you will have the goodness to receive them.

I am, Sir,
Yours, &c.
Hezron.

London, August 18, 1830.

Additional Subscriptions received.

G. S. - - - 7*s.* 6*d.*
R. C. Jun. - - 1 0

PERPETUAL MOTION.

"I believe there *are* principles, could they be brought into action, which would effect the desired purpose, and the difficulty is mostly in the practical application."

Sir, The above is the conclusion of "Hezron's" letter in your 366th Number, who, "at some sacrifice of valuable space," has described a perpetual motion, the most unlikely to keep moving that ever was thought of.

Now, sir, if "Hezron" will point out the "*principles*" he speaks of, I will engage to remove every "difficulty" that stands in the way of their "practical application."

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The pursuit of the perpetual motion has been supposed by some to render the same service to mechanics, which the efforts to discover the philosopher's stone are said to have rendered to chemistry: whether or not the latter science has been improved by the dreams of the alchymists, I am not prepared to say; but I think I may assert, without fear of contradiction, that the science of mechanics neither has been, nor ever will be, benefited by the attempts to discover a perpetual motion. What probability is there of persons improving a science, who are *completely ignorant of it?* and this is almost universally the case with perpetual motion-seekers. What benefit has science ever derived from their exertions? I believe *none at all.*

To believe in the possibility of the perpetual motion, involves the absurdity of believing that the same thing may be greater or less than itself. I cannot help lamenting that ingenuity should be thrown away in endeavouring to discover, what, from the nature of things never can exist in this world; when at the same time that ingenuity might be productive of public good, and the private advantage of its possessor, if properly directed.

Yours, &c.

S. Y., an Engineer.

[We do not think that a belief in the possibility of perpetual motion argues such complete ignorance as "S. Y." supposes: of this, at least, we are well satisfied, that "Hezron" possesses both information and ingenuity enough to prove himself a troublesome antagonist to any one, be his scientific attainments what they may. "S. Y." should in candour have noticed that the scheme given in No. 366 was not one of "Hezron's" own, but an attempt to exemplify one of the Marquis of Worcester's century of inventions. Neither do we agree with "S. Y." that the subject is one from the prosecution of which nothing is to be gained to the science of mechanics. We conceive that were the result of the experiments for which "Hezron" solicits subscriptions, to do even no more than this—convince the many hundreds—thousands we may say, who still cherish the notion, that a perpetual motion is possible, of the fallacy of the thing, it would do a great deal of good, inasmuch as it would direct into channels of practical utility, all that labour and ingenuity, which are now fruitlessly spent in pursuit of the (alleged) chimera.—ED. M. M.]

To Hezron.

Sir,—I hope the subscription to aid you in the manufacture of self-moving machinery will soon be filled up, the sum you require being so small. To forward your views as much as is in my power, I am making interest for you among my friends.

Presuming from the tenor of the paragraph in the "Mechanics' Magazine" of the 14th inst., that you will yourself be engaged in constructing the models, I take the liberty to suggest a plan for expediting the work. You will require several articles in metal, wood, &c., of which you might easily form a list, stating some of the most material, their size, weight, and so forth. By this means you would put it in the power of many a good-natured, industrious mechanic to contribute largely to your assistance; for I am inclined to think there are in London alone many who would willingly come forward with 10 or 20 shillings worth of *labour*, who perhaps could ill spare a comparatively small amount in money.

It is my confirmed opinion, that should you think proper to lay such a statement before the wide circle of ingenious and enlightened readers of the "Mechanics' Magazine," the poorest will not be among the last to proffer his mite. You would thus soon collect an abundance of wheels, woodwork, and other requisites.

Wishing you better success in your undertaking than your predecessors,

I am, yours, &c.

A CONSTANT READER.

London, Aug. 24, 1830.

POULTRY.

Sir,—Perhaps you will think the following questions irrelevant for your Magazine; but as the solution of them involves a consideration, whether or not your readers can hereafter eat their poultry at a reasonable rate, I will venture to try, if you will find me a corner in your wide-spreading publication.

Has any one of your readers seen or heard of a disease in the lower part of the wind-pipe of domestic fowls and

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turkeys communicating with the lungs, which disease commencing soon after hatching, increases from day to day, and at last ends in suffocation to the birds affected.

If so, has any one taken particular notice of the complaint to be satisfied of its origin? To me, as far as I have made the observation, it appears to proceed from the inner, deep-seated part of the wind-pipe next to the lungs being filled with small red worms, with flattish heads, some measuring an inch long and the 20th part of an inch in diameter, others very minute, but all strongly attached to the inner surface of the membrane they adhere to.

Has any one attempted a cure for this disorder; and if success has attended the attempt, what was the process?

The devastation in the poultry-yard arising from this epidemic among young chickens and turkeys, is past belief; and as it has not been yet heard of in some places, I trust one or other of your medical readers, who are partial to roast chicken or turkey, will inquire into the matter, and prevent the disease from spreading farther, if possible.

I am, Sir,

Yours, &c.

GALLUS.

August 14, 1820.

DANGER OF SPONTANEOUS IGNITION.

(From the Newfoundlander.)

On the night of the 16th of May, about eleven o'clock, Mr. T. Holdsworth Brooking, while writing in his office, was much annoyed by a nauseous smell, evidently occasioned by the burning of linseed oil: this having increased, led to a strict and diligent search. In the course of 40 minutes, smoke was observed issuing from the end of one of the storehouses of Messrs. Robinson and Brooking, and before the door could be opened combustion took place, and the flame had attained the height of upwards of six feet, when the fire was immediately extinguished without occasioning any serious damage.

Upon inquiry, it appeared that the cooper in drawing some boiled linseed oil from a cask, spilt about a quart of the oil upon the floor, composed of plank—that he immediately wiped it up with about two or three pounds of black oakum, which he carelessly threw behind some casks of spirits (then on draft) against the end of the storehouse. This occurred about seven o'clock. At half-past eight, the store was visited by the keeper, and locked up for the night, without any appearance of fire or unpleasant smell to excite his notice; and all who had access to the store gave the most positive evidence that no lighted candle, cigar, pipe, or fire in any shape, had been admitted in the store during the day.

At the time the fire happened, Fahrenheit's thermometer stood at about 76, but the temperature of the air in the store was no doubt higher while the sun shone upon it earlier in the day, and it is supposed the mercury might have been so high as 80 inside.

Doubts having arisen in the minds of numerous respectable persons as to the probability of spontaneous combustion from linseed oil and oakum, in so short a time, while others questioned altogether the possibility of combustion from those materials, research was made for information upon the subject, and it was only three days since that an account of some cases of spontaneous combustion, bearing strongly upon the circumstances of the fire above alluded to, was discovered by his Excellency the Governor, who condescendingly caused the work (Mackenzie's Experiments in Chemistry) to be sent to Mr. Thomas H. Brooking; when that gentleman immediately resolved to make an experimental trial, with similar substances, on the first day the temperature of the storehouse should be rather above summer heat.

Accordingly, on the 28th instant, the thermometer being from 78 to 80, at a quarter-past two o'clock, a quart of *boiled* linseed oil was spilt on the floor of the storehouses before-mentioned, and immediately wiped up with about two pounds of black oakum, which was placed against the end of the store, where combustion had before taken place. In the course of an hour it began to give out an unpleasant smell; in two hours and forty-five minutes it emitted smoke, which increased rapidly, and, the door of the storehouse being opened, in twenty-two minutes the whole burst into flame: thus satisfying the parties more immediately interested, convincing the minds of those who were sceptical on the subject, and affording to the public a caution which cannot be too rigidly observed

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to prevent spontaneous combustion, especially in this town, chiefly built of wood, and where so much valuable property is deposited.

BRESTSUMMERS.

Sir,—I shall be obliged by being informed whether the brestsummer in Bishopsgate-street has *one* or *two* tie-rods, of 2 inches diameter. It is described as if it had but *one*, but drawn by "Vulcan," as if it had *two*. As the tie-rod has to resist a strain equal to twice the weight laid on the brestsummer, with one tie-rod it would support about fifteen tons safely. This is supposing the thread of the screw would require as great a force to strip it as the bar itself would resist; that the angles shewn in Mr. Davy's sketch are the same as those formed by the parts of the brestsummer; that the iron rod is completely sound and perfect in every part, and the strain on the rod equal to ten tons per square inch sectional area, which is quite enough to calculate on work of this kind.

Mr. Davy is pleased to say, "the observation of your correspondent, 'Vulcan,' respecting the corner house, is absurd." I am sorry to differ with Mr. Davy, but to me the observation seems any thing but absurd. In the event of the tie-rod failing (which is what "Vulcan" is apprehensive of), the house would still be safe from falling, if the timber of the brestsummer had a firm abutment at each end to sustain the thrust; a few firmly-built houses would form such an abutment; but a *corner house* forms *no such thing*, but leaves the safety of the building, supported by the brestsummer, *entirely dependent on the tie-rod*. "Vulcan's" remark seems to me very important.

When my question as to the tie-rods is answered, you shall hear from me again on the subject.—Yours, &c.

S. Y. (an Engineer.)

[T. M. B. on the same subject in our next.]

MINOR CORRESPONDENCE.

Saul's Sash-Lines.—Sir, In your 366th Number there is a method of replacing sash-lines, by Mr. Saul, but I cannot conceive how the line that is to be in is fastened to the weight without taking out the beads. If the beads must be removed, this will render the improvement useless.—Yours, &c. J. E. BANFIELD. *Kensington, August 23, 1830.*

Double-Acting Pump.—Sir, I presume the description of the double-*power* pump, given at p. 389, was written previously to the appearance of your 359th Number; I need, therefore, only refer your correspondent "Benevolo" to p. 281 in that Number, for an opinion of the merits of this form of pump, by one of the first engineers of the age, Professor Millington; and also for the name of the *first* inventor.

Yours respectfully,

WM. BADDELEY, Jun.

Protection from Fire.—"A two-gallon pitcher of water in each room, especially bed-rooms with curtains, &c., has once, certainly, saved my residence from destruction; and I have reason to believe has several times preserved it so promptly and effectually, as to have kept the carelessness of the cause from my (certain) knowledge."—D. S.

INTERIM NOTICES.

The present Number concludes our 13th volume. The Supplement, including Titles, Preface, Index, and Portrait, Price Sixpence, will be published, along with Part 92, on the 1st of October next.

Part 92 will contain a full account of the opening of the Liverpool and Manchester Railway, on the 15th of September next, with a variety of additional information respecting that important undertaking.

The Critical Retrospect, by our able correspondent, Jonathan Dawplucker, is reserved for an early place in our next volume.

W. B. can be supplied with the Numbers he wants.

A letter for Y. M. lies at our office.

Communications received from Mr. Todd (from whom we shall be glad to hear often)—Mr. Hayter—Mr. Charles Hughes—S. P. W.—E. S. L.—W. B.—Mr. Tustian.

Errata in Physical Essays, vol. xiii.—No. 2, p. 172, for "But if all creation was to move in one direction to each part with the same velocity," read "in one direction, each part with the same velocity."

Ibid. col. 2, line 29, for "the pressure of which," read "the presence of which."

P. 173, col. 2, line 10, for "sphericals," read "spherical."

P. 174, col. 2, line 21, for "ice-water," read "water at 32° F."

No. 3, p. 267, for "1st. When heat exists in a free or sensible state," reads "When heat is latent."

Ibid. for "2nd. When heat is latent," read "When heat exists in a free or sensible state."

P. 269, col. 2, line 4, for "inconsiderable," read "considerable."

P. 270, col. 1, line 31, for "approach," read "opponent."

Errata.—P. 431, col. 1, line 18, for "meaning," read "measuring."

Ibid. line 41, after "size," insert "the interior portions being straight lines."

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END OF VOL. XIII.

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LIST OF NEW PATENTS.

Continued from the 27th of February, 1830, to the 22nd of July

J. Braithwaite and J. Ericsson, of the New Road, Middlesex, for an improved method of manufacturing salt.—27th February, 1830. Two months.

Enoch W. Rudder and R. Martineau, of Birmingham, Warwick, for certain improvements in cocks for draining off liquids.—27th Feb., 1830. Six months.

C. R. Baron de Berenger, of St. Pancras, Middlesex, for improvements in fire-arms, &c.—27th February, 1830. Six months.

H. Hirst, of Leeds, York, for certain improvements in manufacturing woollen cloth.—27th February, 1830. Six months.

M. Poole, of Lincoln's Inn, for a certain combination of, or improvement in, springs applicable to carriages and other purposes. Communicated by a foreigner. 27th February, 1830. Two months.

J. Chesseborough Dyer, of Manchester, Lancaster, for certain improvements on, and additions to, machines or machinery to be used and applied for conducting to, and winding upon, spools, bobbins, or barcels, rovings of cotton, flax, wool, &c. Communicated by a foreigner.—27th Feb., 1830. Six months.

W. Grisenthwaite, of Nottingham, for certain improvements in steam engines.—27th February 1830. Six months.

R. W. Sievier, of Southampton Row, Russell Square, St. George's, Bloomsbury, Middlesex, for certain improvements in the construction of rudders in navigating vessels.—27th Feb., 1830. Six months.

S. Thompson, of Great Yarmouth, Norfolk, for certain improvements in piano-fortes.—27th February, 1830. Six months.

W. Howard, of Rotherhithe, Surrey, for certain improvements in the construction of wheels for carriages.—27th Feb., 1830. Six months.

P. C. de la Garde, Exeter, for certain improvements in apparatus for fidding and unfidding masts, and in masting and rigging of vessels.—27th February, 1830. Six months.

T. Prosser, Worcester, for certain improvements in the construction of window sashes, &c.—6th March, 1830. Six months.

T. R. Guppy, Bristol, for a new apparatus for granulating sugar.—6th March, 1830. Six months.

R. Stevenson, of Colridge, for improvements in machinery for making from clay, or other suitable materials, quarries, bricks, tiles, &c.—6th March, 1830. Six months.

J. Ramsay and A. Ramsay, of Greenock, North Britain, and M. Orr, of Greenock aforesaid, for an improvement in the manufacture of canvass and sail-cloth for the making of sails.—20th March, 1830. Six months.

G. Scott, of Water Lane, London, for certain improvements in windlasses, &c.—20th March, 1830. Six months.

J. A. Fulton, of Lawrance Pountney Lane, Cannon Street, London, for an improvement in the preparation of pepper.—20th March, 1830. Six months.

W. E. Cochrane, of Regent Street, Middlesex, for an improvement or improvements on his patent cooking apparatus.—20th March, 1830. Six months.

B. Rotch, of Furnival's Inn, Middlesex, for improved guards or protections for horses' legs and feet under certain circumstances.—20th March, 1830.—Twelve months.

J. Rowe, jun., of Albany Street, Regent's Park, Middlesex, being one of the people called Quakers, and J. Boase, of the same place, for certain improvements in steam-boilers.—30th March. Six months.

W. Aitkin, of Carron Yale, Scotland, for certain improvements in the means of keeping or preserving beer, ale, and other fermented liquors.—30th March. Six months.

D. Towers Shears, of Bankside, Borough of Southwark, Surrey, for certain additions to and improvements in the apparatus used in distilling.—31st March. Two months.

J. Collier, of Newman Street, Oxford Street, St. Mary-le-bone, Middlesex, and H. Pinkers, of Thayer Street, Manchester Square, in the same parish, for an improved method, and apparatus for generating gas for illumination.—5th April. Six months.

W. A. Summers, St. George's Place, St. George's in the East, Middlesex, and N. Ogle, of Milbrook, Hants, for certain improvements in engine and other boilers or generators, applicable to propelling vessels, locomotive carriages and other purposes.—15th April. Six months.

J. Perry, of Red Lion Square, Holborn, bookseller, for an improvement or improvements in or on pens.—24th April. Six months.

J. M. Innes, of Auchenech, and of Woodburn, North Britain, Esq., for the manufacture or preparation of certain substances, which he denominates the British tapioca, and the cakes and flour to be made from the same.—24th April. Six months.

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S. Brown, of Billiter Square, London, Commander in our Royal Navy, for certain improvements in making or manufacturing bolts and chains.—24th April. Six months.

J. Cochaux, of Fenchurch Street, London, merchant, for an apparatus to prevent or render less frequent the explosion of boilers in generating steam. Communicated by a foreigner.—24th April. Six months.

P. Descroizilles, of Fenchurch Street, London, Chemist, for certain improvements in apparatus for economising fuel in heating water and air, applicable to various purposes.—24th April. Six months.

T. Cook, of Blackheath Road, Lieutenant in our Royal Navy, for certain improvements in the construction and fitting up of boats.—24th April. Two months.

T. Wilks, of Blue Anchor, Bermondsey, Engineer, &c., for an improvement or improvements in a part or parts of the apparatus for making paper by machinery.—28th April. Six months.

T. Petherick, of Penfullick, Cornwall, Mine Agent, for machinery for separating copper, lead and other ores, from earthly and other substances, with which they are or may be mixed, and which is more particularly intended to supersede the operation now practised or used for that purpose, commonly called jigging.—28th April. Six months.

J. Walker, of Weymouth, Middlesex, Esq., for an improved cock for fluids.—14th May. Six months.

H. R. S. Devenage, of Little Stanhope Street, May Fair, Gentleman, for certain improvements of machinery for making bricks. Communicated by a foreigner.—8th May. Six months.

M. Bust, of Dalmonarch, Print Field, near Bonhill, by Dumbarton, North Britain, for certain improvements in machinery or apparatus for printing calico and other fabrics.—24th May. Six months.

J. Holmes Bass, of Hatton Garden, London, for certain improvements in machinery, for cutting corks and bungs.—3d June. Six months.

J. Levers, of New Radford Works, near Nottingham, for certain improvements in machinery for making lace, commonly called bobbin-net.—8th June.—Six months.

G. Vaughan Palmer, of Worcester, for a machine to cut and excavate earth.—8th June. Six months.

W. T. Haycraft, of Greenwich, for certain improvements in steam engines.—11th June. Six months.

T. Brunton, of Commercial Road, Limehouse, and J. T. Fuller, of the same place, for an improved mechanical power, applicable to machinery of different descriptions.—19th June. Six months.

R. Hicks, of Conduit Street, Hanover Square, Middlesex, for a machine to be applied in the process of baking.—29th June. Six months.

E. Turner, of Gower Street, Middlesex, M. D. and W. Shand, of the Burn in Kincardineshire, for a method of purifying and whitening sugar or other saccharine matter.—29th June. Six months.

S. Parker, of Argyle Street, Oxford Street, for improvements in producing mechanical power from chemical agents. 29th June. Six months.

S. Parker, of Argyle Street, Oxford Street, for an improved lamp.—29th June. Six months.

R. Roberts, Manchester, for improvements in the machines known by the name of mule, billy, jenny, jack, stretching frame, &c.—1st July. Six months.

J. H. Clive, of Chell House, Stafford, Esq., for improvements in the construction of locomotive ploughs, harrows, and other machines and carriages.—1st July. Six months.

M. Uzielli, of Clifton Street, Finsbury Square, Middlesex, for improvements in the preparation of certain metallic substances, and the application thereof to the sheathing of ships and other purposes. 6th July. Six months.

J. Surman, of Hounslow Barracks, Middlesex, Riding Master in the Tenth Hussars, for improvements on bits for horses and other animals.—6th July. Two months.

W. Tuxford, of Boston, Lincoln, for a machine for cleansing or purifying wheat, grain, or other substances.—6th July. Six months.

E. Cowper, of Streatham Place, Surrey, and E. Cowper, of Suffolk Street, Pall Mall East, Westminster, for improvements on printing machines.—19th July, 1830. Six months.

J. Rowe, jun. of Albany Street, Regent's Park, Middlesex, and J. Boase, of the same place, for improvements in steam carriages and in boilers, and a method of producing increase of draft.—19th July. Six months.

T. Bulkeley, of Albany Street, Regent Street, Regent's Park, M.D. for improvements in propelling vessels, which improvements are also applicable to other purposes.—19th July. Six months.

W. Taylor, of Wendesbury, Stafford, Engineer, for improvements on boilers, and apparatus connected therewith, applicable to steam engines and other purposes.—19th July.—Six months.

E. Riley, of Skinner Street, Bishopsgate Street, Middlesex, for improvements in the process and apparatus for fermenting malt and other liquors.—19th July. Six months.

G. Oldland, of Hillsley, Gloucester, for improvements on the apparatus for shearing and dressing woollen cloth, and other fabrics.—22nd July. Six months.

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ERRORS OF THE PRESS IN VOL. XIII.

Page 14, column 1, line 40, for "at p. 238, vol. iii." read "at p. 212, vol. viii."

Ibid. column 1, line 48, for "$M \times \frac{p}{t} W$," read "$M = \frac{p}{t} W$."

Ibid. column 1, line 56, for "at p. 212, vol. viii." read "at p. 358. vol. iii.

(*The preceding errata in a few copies only.*)

Page 170, column 1, line 15, for "with what were called plates similar to what is known by the name of parquetting," read "with what are called plates coated with a composition similar to that known by the name of pargetting."

Page 171, column 1, last line, for "strong posts," read "storg posts."

Page 172, column 1, line 12, for "But if all creation was to move in one direction to each part with the same velocity," read "in one direction each part with the same velocity."

Ibid. column 2, line 29, for "the pressure of which," read "the presence of which."

Page 173, column 2, line 10, for "sphericals," read "spherical."

Page 174, column 2, line 21, for "ice-water," read "water at 32° Fah."

Page 227. The relative proportions of ancient bridges should be altered as follows:—

Illyssus at Athens, for "$\frac{5}{1}$," read "$\frac{5}{12}$."
Loire at Orleans, for "5579," read "5·579."
Rimini, for "$\frac{5}{2}$," read "$\frac{5}{12}$."

Ibid. for "over the Seine at Nantes," read "ever the Seine at Mantes."

Page 228, for "150 feet as the span of New London Bridge," read "152 feet."

Ibid. column 2, line 12, for "Derbyshire granite," read "Devonshire granite."

Page 253, column 1, line 13, for "3·14152259259," read "3·14159259259,"

Page 267, column 1, line 54, for "1st. When heat exists in a free or sensible state," read "When heat is latent."

Ibid. column 1, line 56, for "2d. When heat is latent," read "When heat exists in a free or sensible state."

Page 269, column 2, line 4, for "inconsiderable," read "considerable."

Page 270, column 1, line 31, for "approach," read "opponent."

Page 271, column 2, line 7 from the bottom, for "Mechanical," read "Mathematical."

Page 272, in the 5th new mathematical question, for "the locus of which will be in a straight line," read "the locus of which will be a straight line."

Page 279, column 2, line 18, for "301bs." read "300lbs." In the logarithmic calculation, the fraction $\frac{1}{2}$ is misplaced; it ought to have been two lines lower down, viz. against log. 40459, which is half of 80919 next above or in the third row, being the difference of the two first logarithms.

Page 335, column 1, line 10, for "P*m*," read "*pm*."

Ibid. column 11, for "PC*m*," read "*p*C*m*."

Ibid. column 2, line 6, for "P*m*," read "*pm*."

Page 351, question 2, for "any rectilineal given," read "rectilineal triangle given."

Page 356, for "the upper *d*, in the figure," read "*b*."

Ibid. column 1, line 12 from the bottom, for "the discharge of a maximum," read "the discharge a maximum."

Page 431, column 1, line 18, for "meaning," read "measuring."

Ibid. column 1, line 41, after "size," insert "the interior portions being straight lines."

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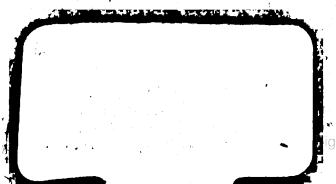

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